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IRON and STEEL ENGINEER

FUEL — ELECTRICITY — MACHINERY — METHODS

EMPIRE BUILDING, PITTSBURGH, PA.

To Educate the Engineer in Industry

JANUARY, 1924

Containing the Proceedings of the A.I.&S.E.E.

Standardization • Automatic Substations

Pittsburgh's Iron and Steel Exposition

Program of District Sections

Fuel Saving Conference • Improvement in Rotors

Achievements in the Steel Industry During the Year 1923

The Million Dollar Iron and Steel Exposition

Membership List of A. I. & S. E. E.

Some Electrical Developments

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IRON AND STEEL ENGINEER

J. F. KELLY, Editor

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JAMES FARRINGTON

A steel mill engineer, who proposed and fathered the formation of the Association of Iron and Steel Electrical Engineers.

THE IRON AND STEEL ENGINEER, in its first issue, is dedicated to its first president, James Farrington, the steel mill engineer whose foresight and wisdom made possible the inception of the Association of Iron and Steel Electrical Engineers.

Like all successful executives in the steel industry, Mr. Farrington represents the man of thought and action, a man who has struggled long and strenuously to advance knowledge in the field of operation, and with the aid of earlier workers in this Society, gave unsparingly of his time and energy to fan the flame of inquiring minds, and from a small beginning great things have sprung.

In 1907, the Westinghouse Electric & Manufacturing Company invited a number of representative electrical and mechanical engineers to visit their plant at East Pittsburgh to see a special exhibit of electrical apparatus for use in steel mills, and at this meeting Mr. Farrington suggested the formation of a national organization which would tend to promote a closer spirit of co-operation between the engineers of the industry, and thus this Association was born, destined to reach heights far beyond the comprehension of those men at that time.

Today the handiwork of this man has reached international recognition and importance, practically every steel company of any size in the universe has a representative in this Society, and with its hands across the continents and seas, has spread the lights and truths of understanding for the development of the engineer for service.

EDITORIALS

J. F. KELLY, EDITOR

THE "IRON AND STEEL ENGINEER"

The IRON AND STEEL ENGINEER is a monthly magazine containing the proceedings of the Association of Iron and Steel Electrical Engineers and is devoted to the education of the engineer in the industry.

This, the January number, is its initial appearance, and it hopes by its editorials and its messages from the steel mill engineers and from the manufacturers, to further develop the engineer for service.

Live technical topics of current interest to the engineer, discussions by relation of experience with the various problems met, the obstacles overcome by the engineer, will be the basis of our appeal to our subscribers.

The steel mill engineer works for the pleasure of conceiving and executing; the enjoyment of creating, constructing, building; the more he builds, the more he wins, but the building is the main thing. When we say that these are the men who form the greater part of the steel industry, we are not playing to idealism. It pays them as it will pay us, not alone perhaps in profit, but the desire to work for work's sake, and we believe we are right when we say this is the prime object of the great majority of America's engineers.

This magazine will hold for its ideal, the steel mill engineer.

IRON AND STEEL EXPOSITION

September 24-28, 1923

For our readers, we are presenting the Million Dollar Show which was held at Buffalo, N. Y., under the auspices of the Association of Iron and Steel Electrical Engineers.

The usual custom, after a show is over is to quietly fold the tents and fade away, but we feel that the demonstration was so successful and the co-operation offered by the manufacturers so generous, that a pictorial review was in order and due to both the members and the manufacturers, so as to perpetuate the event in the minds of those who were fortunate enough to witness the show. Likewise will this review be well received by those whose duties were such as to warrant their services at home rather than be present at this paricular event.

Those who were present at the first Iron and Steel Exposition, held on the roof of the Hotel Statler in St. Louis in September of 1919, hardly realized that with such a small beginning we would increase in such proportions until today we are proud to say that our Iron and Steel Expositions are known the world over and, while not the largest affair of its kind, it claims to represent an industry attendance larger than any other show in this country.

The 1924 Iron and Steel Exposition will be held in the City of Pittsburgh, and since this is the steel center of the world, it promises to be the largest in our history. While this is the first public announcement that the exposition would be held in Pittsburgh, a number of exhibitors have made inquiries as to the location for 1924, and when informed of the city they all evidenced their hearty approval.

From time to time information will be printed in this magazine respecting our 1924 Exposition, and with such an early start we have every reason to believe that Pittsburgh will furnish a show surpassing both the Buffalo and Cleveland affairs.

AUTOMATIC SUBSTATIONS

The eight-hour day, which is gradually being incorporated in the steel mill industry, urgently requires that the steel mill engineer apply more and more labor-saving devices, not only to save labor costs, but also to reduce power bills. Unless operating conditions can be improved and the average production per man increased by some such means, the eight-hour day may result in increasing the cost of the final product to values that will interfere with good business conditions.

Automatic substations of the kind which have been in general use for some time in the street railway and mining field may be considered as representative of the type of equipment required to produce the results outlined above. These equipments, particularly those which control motor-generator sets or synchronous converters, have made an excellent reputation for economy and reliability through several years of service. While they are not in general use in steel mills, the engineering and operating problems found in a steel mill do not differ greatly from the similar conditions found in a successful street railway or mining property. The application, therefore, of automatic equipment in a steel mill should produce similar results.

YOUR NEW PERIODICAL*

Beginning with this issue, the small 6x9 in. Monthly of this Association is increased in size as well as appearing under the name of "Iron and Steel Engineer." The new issue will be of the regular trade journal size, 9x12 in.

Since this is your periodical and since the data contained therein is part of your daily routine work, we know you will be interested in this announcement.

Neither the old periodical nor the new one we are now publishing is 100 per cent perfect in either the editorial or advertising matter. As a member of this Association, part owner of the periodical and a subscriber, you have the best interests of this magazine at heart.

As one so vitally interested, you are in a position to tell us how the IRON AND STEEL ENGINEER

*Monthly periodical devoted to steel mill engineering, superseding A. I. & S. E. E. Monthly Issue.

can best serve the interest of its subscribers and manufacturers. Please send us your suggestions.

There are today hundreds of mediums which all endeavor, to the best of their ability, to render the class of service which they truly feel will be of the most material interest to their subscribers, the manufacturers and themselves.

The IRON AND STEEL ENGINEER will differ in only one particular with the other reputable mediums, and that is "it will not be operated for profit nor private gain," but absolutely on the basis of service, wholly educational, for the prime purpose of advancing the engineering arts in the iron and steel industry.

Naturally, the first question which comes to your mind is how will this periodical render a genuine service satisfactory to its subscribers and still forget the first lesson in economics—"profit." Our answer to the question is that our editorial staff practically consists of the engineers in the steel industry who contribute to the editorial columns of this medium without cost. Our ability to secure first-hand editorial matter which as a rule is not furnished to the average trade journal.

Our operating overhead in no way compares with that of the trade journals, as you and your fellow engineers are the ones who operate, govern and control the policy of this Society without remuneration.

Every manufacturer in the United States who desires to send his message to the engineers of the steel industry will use the IRON AND STEEL ENGINEER as the medium.

As an owner of the periodical, a member of the Society and a subscriber to the magazine, you should be acquainted with some of the many details connected with your periodical, so that should the question be put to you regarding any particular phase of the issue you may refer to this editorial as your guide.

Editorial Matter.

Each month approximately five papers are presented and discussed before our district sections in Pittsburgh, Philadelphia, Chicago, Birmingham and Cleveland. These papers will form part of the editorial matter of the IRON AND STEEL ENGINEER.

Short contributions which are not extensive enough to be presented before a section meeting, but are worthy of notice for the membership, will also form part of this section of the magazine.

Special Sections.

When the occasion arises where our issue may be of benefit to some individual or company, either in a personal or business way, we will gladly make mention of it in this section.

From time to time new developments will be brought out covering matters of interest to the subscribers and others interested.

In addition to this, other sections and departments will be added as the demand arises.

Advertising Material.

From month to month, the representative manufacturers of material used in the iron and steel industry will deliver full and half page messages to you in order that you may familiarize yourself with just what they have to offer. To these manufacturers we are greatly indebted.

The size of the magazine will be 9x12 in. outside dimensions and this allows inside measurements of 7x10 in.

The circulation is approximately 2,000, and covers Executives, Electrical Superintendents, Electrical Engineers, Chief Engineers, Mechanical Engineers, Combustion Engineers, Master Mechanics, Foundry Engineers, Mining Engineers and some few engineers of the other allied industries.

The rates for advertising are as follows:

	Per Month
12 pages or more during year	$40.00
6 pages or more during year	42.50
3 pages or more during year	45.00
1 single insertion of one page	50.00
12 half pages or more during year	22.50
6 half pages or more during year	25.00
1 half page single insertion	30.00

We trust you will appreciate the purpose of giving you this information and we know that you will not only be interested in reading the messages from month to month, but will have a more personal interest in what your magazine is doing under the name of "Iron and Steel Engineer."

The following is a partial list of the iron and steel and allied industries to which the "Iron and Steel Engineer" will be sent each month:

Acme Steel Goods Co.
Aetna Foundry Co.
Alabama Power Co.
Alan Wood Iron & Steel Co.
Algoma Steel Corp.
Allegheny River Mining Co.
Allegheny Steel Co.
Alliance Machine Co.
Allmanna Svenska Elektriska
American Bridge Co. and Subsidiaries
American Car & Fdry. Co.
American Cast Iron Pipe Co.
American Locomotive Co.
American Rolling Mills Co.
American Sheet & Tin Plate Co. and Subsidiaries
American Steel Foundries
American Steel & Wire Co. and Subsidiaries
Anzan Steel Works
Apollo Steel Company
Appelby Iron Co.
Armstrong Cork Co.
Ashland Iron & Mining Co.
Ashtabula Steel Co.
Atlas Steel Corp.
Automobiles, M. Berliet

Baldwin Locomotive Co.
Baltimore Car & Fdry. Co.
Baltimore County Water, Light & Power Co.
Bellingham Steel Corp.
Berger Manufacturing Co.
Berwind White Corp.
Bessemer Rolling Mills
Bethlehem Steel Companies
Birdsboro Steel Fdry.
Bolckow, Vaughn & Co.
Bradford Iron Works
Braden Copper Co.
Braeburn Steel Co.
Brier Hill Steel Companies
Bridgeport Brass Co.
Brimbo Steel Co.
Broken Hill Proprietary Co.
Buckeye Steel Castings Co.
Buffalo Bolt Co.
Byers Companies, A. M.

Caledonia Woolen Mills
Calumet & Hecla Mining Co.
Calumet Steel Co.
Cambria Steel Co.
Campbell, Wyant & Cannon Fdry. Co.
Canadian Steel Co.
Carnegie Steel Companies
Carpenter Steel Co.
Celluloid Co. of America
Central Mining Co.
Central Steel Co.
Champion Machine & Forge Co.
Chapman Price Co.
Chickasaw Shipbuilding Co.
Cleveland Furnace Co.
Cleveland & Pittsburgh Ore Docks
Cleveland Steel Co.
Cleveland Steel Casting Co.
Coatesville Boiler Works
Colorado Fuel & Iron Co.
Colville & Sons, Ltd., D.
Columbia Chemical Co.
Connors Steel Co., Inc.
Copper Clad Steel Co.
Crucible Steel Companies of America
Cyclops Steel & Iron Co.

Davison Chemical Co.
Disston & Sons, Inc., Henry
Dominion Steel Foundries
Donner Steel Co.
Donner Union Coke Co.
Duquesne Steel Fdry. Co.

Eastman Kodak Co.
Eastern Malleable Iron Co.
Ebinger Sanitary Mfg. Co., D. A.
Edgewater Steel Co.
Eddystone Mfg. Co.
Electric Alloy Steel Co.
Elyria Iron Co.
Erie Forge Co.

Federal Shipbuilding Co.
Florence Pipe Fdry. & Machine Co.
Follansbee Brothers Co.
Forca E Luz
Ford Motor Co.
Forge Steel Wheel Co.
Fort Pitt Steel Co.
Fort Pitt Malleable Iron Co.
Fort Pitt Steel Casting Co.
Frick Coke Co., H. C.

Gary Screw & Bolt Co.
Goodman Mfg. Co.
Gulf States Steel Co.

Halcomb Steel Co.
Harlan & Hollingsworth
Harris Automatic Press Co.
Harrisburg Pipe & Pipe Bending Co.
Hess Steel Corp.
Hudson Coal Co.

Illinois Steel Companies
Indiana Steel Co.
Inland Steel Companies

International Lead Refining Co.
Interstate Iron & Steel Co.
International Nickel Co.

Japan Steel Works
Johnson Bronze Co.
Johnson & Sons, Ltd., R.
Jones & Laughlin Steel Cos.

Kayser Ellison Co.
Kelly Springfield Tire Co.
Keystone Steel & Wire Co.
Koppers Co., The H.
Kirby Mfg. Co.

La Belle Iron Works
Laclede Steel Co.
Lackawanna Steel Co.
Lebanon Steel Foundries
Lebanon Valley Iron & Steel Co.
LeFlaive & Co.
Lehigh Valley Railroad Co.
Lewis Fdry. & Machine Co.
Llewellyn Iron Works
Lorain Steel Co.
Louisville & Nashville Railroad Co.
Lukens Steel Co.

Mackintosh-Hemphill Co.
Mahoning Valley Steel Co.
Marine Engineering Corp.
Mesta Machine Co.
Midvale Steel Companies
Minnesota Steel Co.
Monongahela Connecting Ry. Co.
Morgan Construction Co.
Morgan Engineering Co.
Morris & Bailey Steel Co.
Motherwell Iron & Steel Co.

McConway Torley Co.
McKeesport Tin Plate Co.
McKinney Steel Co.

Nagle Steel Co.
National Enameling & Stamping Co.
National Farm Mchy. Co.
National Malleable Castings Co.
National Tube Companies
New Jersey Zinc Co.

Ohio Steel Fdry. Co.
Otis Steel Companies

Page Steel & Wire Co.
Park Gate Iron & Steel Co.
Parkersburg Iron Co.
Penn Seaboard Steel Co.
Philadelphia Roll & Machine Co.
Pittsburgh & Conneaut Dock Co.
Pittsburgh Crucible Steel Co.
Pittsburgh Rolls Corp.
Pittsburgh Screw & Bolt Co.
Pittsburgh Seamless Tube Co.
Pittsburgh Steel Co.
Pittsburgh Steel Product Co.
Port Henry Iron Co.
Pressed Steel Car Co.

Railway Steel Springs Co.
Reading Iron Co.
Republic Iron & Steel Cos.
Republic Rubber Companies

Schneider & Co.
Scullin Steel Co.
Sellers Mfg. Co.
Semet Solvay Companies
Sezione "Ferriere Piementesi"
Sharon Steel Hoop Companies
Shelby Steel Co.
Shenango Furnace Co.
Shoemaker & Satterthwaite Bridge Co.
Sloss Sheffield Steel & Iron Co.
Southern Carbon Co.
Spang Chalfant Co.
St. Louis Coke & Chemical Co.
Standard Seamless Tube Co.
Standard Steel Car Co.
Standard Steel Works
Standard Tin Plate Co.
Steel Co. of Canada
Stockham Pipe & Fittings Co.
Stewart Furnace Co.
Superior Sheet Steel Co.
Superior Steel Co.

Tata Iron & Steel Co.
Taylor Brothers & Co.
Tennessee Coal, Iron & Railroad Co.
Treadwell Engineering Co.
Trumbull & Cliffs Furnace Co.
Trumbull Steel Co.
Truscon Steel Co.
Tyler Tube & Pipe Co.

Union Rolling Mills Co.
United Alloy Co.
United Engineering & Fdry. Co.
United States Cast Iron Pipe Co.
Universal Portland Cement Co.
Universal Steel Co.
Upson Nut Co.

Valley Mold & Iron Co.
Vanadium Corp. of America
Van Dorn Iron Works
Vulcan Iron Works

Walther & Sons, L. B.
Weirton Steel Co.
West Leechburg Steel Co.
West Penn Steel Co.
Wheeling Mold & Fdry. Co.
Wheeling Steel Corp.
Wickwire Spencer Steel Co.
Wilmington Malleable Iron Works
Wilson Snyder Mfg. Co.
Wisconsin Steel Co.
Witherow Steel Co.
Woodward Iron & Steel Co.
Worth Steel Co.
Wycoff Drawn Steel Co.

Youngstown Sheet & Tube Co.

Standardization

By F. W. CRAMER*

ANOTHER year has been added to the history of the A. I. & S. E. E., a year which gave promise of great accomplishments along the lines of standardization, yet as we write up the results of our labors we find that suggestions rather than accomplished results form the basis of the reports. To those of us who are actively engaged in the purchase and operation of electrical equipment in the steel industry, the question of how to reduce the endless variety of apparatus and spare parts remains one of the unsolved problems.

Two years ago our Crane Code was presented before the Association at the Chicago Convention. This outline of specifications for steel mill cranes represented the results of several years' work on the part of mill operators and crane designers who had the welfare of the Association at heart, yet at that time the small minority, who have nothing to offer except destructive criticism, were on hand to hinder rather than to help put the code across. Happily, we can say this destructive criticism was not sufficient to block the adoption of the code, and if the thousands of copies that have been distributed to our membership as well as to others can be taken as a criterion, the members who gave their time and their energy to this work can rest assured that we are now reaping rewards. This particular code is now undergoing the test of time, and as its shortcomings and defects are discovered steps will be taken to have them rectified.

For the past year our thoughts have been centered on motors and control equipment. These subjects are so large and are so intricately interwoven with design problems and engineering initiative that the starting point of standardization is rather elusive and hard to find.

For the past several years an attempt has been made to standardize a given number of sizes of motors, the reason being that at present there are too many sizes being manufactured. When discussing what sizes would be desirable, the question of what rating to use in selecting the sizes was never settled. The recent decisions on 40-deg. or 50-deg. motors and changes in overload capacities have the average mill operator so confused he feels that, for instance, a 25-hp. motor is something different every few years. It appears that our first duty would be to define what we mean by a motor of a given hp. The motor ratings and specifications seem to be determined by manufacturers and societies other than our own while we sit idly by and accept the decisions. The unfortunate circumstance connected with these other societies is that the manufacturers are usually in charge of the committees, and the operator who actually keeps and installs the motor is not consulted about the changes of design. This hardly seems fair to the industry we represent, whose motor purchases run into millions of dollars every year.

Another active motor question is the problem of standardizing the bolt hole dimensions, but when this is sifted down to real facts, the determining of these dimensions for different motors seems like an insurmountable difficulty. The thought in the minds of the committee was that the existing motor types would some day be replaced by new types and that when such a change was contemplated the designer would have a standard bolt hole plan to work with. Thus a motor of a given speed, voltage and horsepower would have standard bolt hole dimensions and this should not in any way limit designing initiative or curb competition. It seems strange that the few manufacturers of mill type motors could not get together and adopt a standard bolt hole plan for these motors unless it is because selfish or commercial inter-

*Chairman Standardization Committee.

ests mean more to them than the interest of the prospective purchaser.

Another motor problem is that of shaft diameters. Surely metallurgical calculations have reached a point of such precision that if a 3-inch shaft is the proper one for a 50-hp. mill type motor of a given speed, a shaft 2⅞ inches in diameter would be too small and one 3⅛ inches in diameter too large. These are only two of many examples which, although they may seem trifling to an outsider, are a cause of unnecessary trouble and storeroom expense to the steel mill operator. Mr. D. M. Petty and other members of the motors committee have devoted several years of effort to questions such as these, but so far, due perhaps to the lack of co-operation of our active members, the manufacturers have succeeded in evading a decision in this matter.

Control is another one of our important subjects. There must be 10,000 or more control parts now being manufactured, and in plants where all new business is let by the purchasing department to the low bidder, a complete museum of these parts is necessary to insure satisfactory operation. For instance, if we consider the contactors themselves we find that there is no such a thing as a contactor rating basis—such as area of contact surfaces, number of breaks per minute, maximum interrupting capacity, etc., recognized by the manufacturers. Each one has a different basis and the only way the mill operators can compare contactors is by buying them and giving them a trial. The coils, resistance tubes and grids are likewise of all shapes and forms and, as was called to your attention last year, the different engineers of the same company often will not agree on combinations for a given job.

It is true that when control matters are taken up with the manufacturers, a cordial greeting is always extended and the assurance given that they will build anything we want if we are willing to pay the price. But who are "we"? The committee has no assurance of what the individual steel companies will insist upon for control equipment, and it seems there are as many different opinions on this subject as we have active members. This is not meant for a criticism of our body, as individuals, as it shows there is initiative everywhere, but the immense problem of assembling and condensing these many ideas into a single plan that would have the undivided support of our membership will require years of patience and lots of work. Many of our prominent concerns are not waiting for the Association to act on this matter and have set a standard of their own and buy only one make of control. More and more we find that a set of detailed specifications now accompany the inquiry for new apparatus that insures proposals on equipment of a similar nature. These are good signs in favor of control standardization whose progress is slow but sure. Possibly within another year, the committee will be able to touch upon the right plan or starting point and control standardization will become more of a reality control standardization will become more of a reality than we have dared to hope for.

While there is not much concrete evidence to offer, we have the satisfaction of knowing that our suggestions are taking root and beginning to grow. This big problem now is getting the concerted efforts of the members back of the committee. The easiest thing to do is to knock and criticize—what we want is a boost with some constructive criticism and a little of your time devoted to sending in suggestions. We realize that the working hours of the average mill operator are usually filled and overflowing with daily routine work and that the time he can devote to Association matters must be taken in the evening or perhaps Sundays. But does it seem fair that a work of such importance as this should be shouldered by less than a dozen members? This small group have been fighting for the benefit of the entire membership and through their continual hammering and pounding have done wonders in raising the prestige of the electrical engineer in the steel business. If they had ever quit or lacked the courage and foresight to carry on, we might still be a branch of the mechanical department or just one of the necessary evils of the industry.

As a final subject, I wish to call your attention again to activities of other societies, particularly the American engineering standards committee, who are doing a great deal of good work along these lines. What is to be our policy towards them—shall we sit idly by, fearing co-operation with them lest we have something put over on us, or attempt in some diplomatic way to have a part in their discussions on matters of interest to us and voice your opinion? That is a question many of us have debated, and it seems that their influence on standardization has become so great that action on our part is necessary. We are all working for the same cause, standardization, and standardization means economy to everybody — a saving in dollars and cents that will appear on the books. Why not fall in line and work with them and possibly incorporate some of our own ideas in apparatus in which we are vitally concerned?

In summarizing the work, we can all report progress. What we need more than anything else is co-operation of all our members so that we, the Standardization Committee, can feel that you all are really back of us. I have offered a suggestion that the Board of Directors be authorized to approach the management of the U. S. Steel Corporation, the Bethlehem Steel Company, the Republic Steel Company, Jones & Laughlin, Youngstown Sheet Iron & Tube Company and all the other steel companies, suggesting that each and every one of them appoint a man from their organization to work with the A. I. & S. E. E. to devise ways and means for the standardization of the electrical apparatus in the steel industry, and if this is accomplished, you can rest assured that the steel industry is big enough and powerful enough to put it across.

1922 YEARLY PROCEEDINGS

This yearly book is the largest one ever published in the history of the Association and contains 966 pages of matter of interest to the engineers in the iron and steel and allied industries.

These proceedings have been sent out to the members of the Society, and considerable favorable comment has been received from the recipients.

The Combustion Engineering Section of the Association is responsible for the presentation and discussion of some 20 articles, which is an indication of the healthy growth of their two-year connection with this Society.

*Automatic Substations**

By R. F. WENSLEY†

IN approaching the subject of automatic control, I usually try to think of the basic economical laws underlying the entire structure of modern civilization. As the varied activities of our modern life become more complex we demand more of what were once called luxuries but have now become necessities. To comply with this demand it is absolutely necessary that the unit productivity per man be increased. It is no longer possible for the individual family to be self sustaining, as once was the case. Should we attempt a return to the agricultural age, the whole fabric of our modern civilization would crumble. Our present day mode of living is made possible by the substitution of mechanical devices for human hands and human brains. We are compelled by the necessities of this marvelous age to build machines that will do delicate work in a manner much superior to the best craftsman, and many times faster. Indeed the apparent power of some of the machines to reason, almost make us believe that we have endowed them with the power to think.

I was forcibly reminded of the possibilities that lie in automatic control of mechanical operations when Mr. Friedlaender explained to us the operation of the charging devices for the blast furnaces this afternoon. We saw two men guiding mechanical devices that replace the labor of 32 men thus releasing 30 men for work at some other task where human hands cannot be replaced by machinery at the present time. It is only the perfection of such methods that make possible low production costs with high priced labor.

The development of automatic switching for the control of sub-station and power station apparatus is only another step in the reduction of the high priced labor content in production costs. Naturally we are not able to show such startling reduction in quantity of labor as the case cited above but in percentage we cannot be beaten because we reduce the labor content to zero per cent and that seems to be the limit.

The management of the Edgar Thomson Works, realizing the economics to be gained by automatic operation, have contracted for the necessary equipment to replace every operator of sub-station and mill motor control. There will be no operators of this description in the entire plant. This is a real step forward and we deem ourselves very fortunate in having been delegated by the Carnegie Steel Company to carry out this important change. I think this will be the first large installation of fully automatic substation control for steel mill use in the World.

In designing automatic control for a plant so important as the one we saw this afternoon we must always keep before us the basic requirement of extreme reliability. We dare not consider the use of some doubtful piece of apparatus or method. Every detail must be as near perfection as human intelligence can achieve. If power fails with hot steel in the rolls or with ladles in the air the consequences, while possibly not hazardous to life, are highly disagreeable to the pocket book, because steel stopped in the rolls costs real money. The overhead expense in a big plant amounts to a real fortune every day and the failure of one relay contact may cost a thousand dollars. If that failure could be prevented by plating the contact with gold or platinum or even by using solid platinum, it must be done for we dare not chance the failure. The motto of the electrical department must be "Service Above Everything."

The necessary presence of dust, scale, grit and grease in the mills makes this a really serious problem. Every delicate part must be sealed against the entry of such foreign matter and also against the unintelligent labor that may be used for cleaning the stations. Only a high grade maintenance man should be allowed to remove such protective coverings.

Our automatic industry to date has been principally confied to electric railway and lighting stations. I have never had the opportunity to inspect a large mill in such a thorough manner as was afforded us this afternoon. It was my first inspection of a large steel mill, and, frankly, I was amazed to see the conditions under which electrical apparatus actually operates in a mill and I have a much greater respect for the ruggedness of such equipment than when I came here this afternoon.

Since this is to be a pioneer installation of the sort there are no available pictures of automatic sub-stations in steel mill service. The illustrations therefore are of automatic switching equipment used in railway, lighting or mining sub-stations.

As I have previously mentioned, the relays must be enclosed to prevent entry of foreign matter. We therefore use a small multicontact relay in a cast iron box (Fig. 1), for all auxiliary circuits where no considerable amount of current must be handled. This relay has a solid cast iron cover with a felt gasket.

The induction relay in various forms is used for protective purposes wherever possible. The type C.O. induction overload relay (Fig. 2), is typical of the class. We also use the type C.V. single phase voltage relay and the type C.P. polyphase voltage relays. The latter relay offers protection against attempt to start when only single phase voltage is available. It does not protect against open phase after the machine is connected to the line with field on because the machine acts as a phase balancer and maintains a polyphase voltage even with one phase open. To fully guard against the latter contingency the type C.M. phase balance current relay is used (Fig. 3). In this relay are two mechanically independent discs, each disc being in the air gap of two induction driving elements. The phase splitting winding is reversed on one of the elements so that the torques are in the opposite direction.

On one element phase A is balanced against phase B. On the other element B against C. The current values in the three phases being equal, all the rotative efforts are equal and opposite. Should a phase open, the disc affected would be rotated by the induction element in the good phase until the contacts close. Since the polyphase voltage relay guarantees that the

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†Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

line is normal just prior to the closing of the starting switch, the operation of the phase balance relay during the starting period is taken as sufficient evidence that a local fault exists. The contacts of the phase balance relay cause the operation of the lockout relay thus taking the equipment out of service until inspected and repaired. After the running switch is closed, it is reasonable to assume that operation of the phase balance relay indicates line trouble. The contact circuit

Overheating of the coils may result in even more damage than overheating of the bearings. A thermal relay (Fig. 6), is connected in the secondary of a current transformer in the supply circuit. In the lower part of this relay is a ratio coil, which enables accurate adjustment of the relay to a given machine although using a standard ratio current transformer. This coil also serves to prevent damage to the sensitive element of the relay by short circuit currents since the

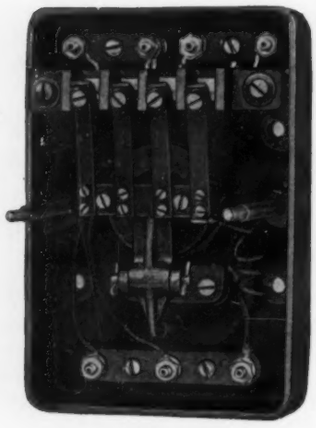

FIG. 1.

FIG. 2.

FIG. 3.

of the phase balance relay is transferred from the lockout to the master relay when the transition from starting to running is made. When stopped by phase trouble in this manner the equipment will again start as soon as permitted by the polyphase voltage relay, or in other words, as soon as the line trouble has been rectified.

One of the possible troubles that must be carefully guarded against at all times is that of heating in the bearings. The automatically controlled unit is promptly shut down by a bearing thermostat should the bearing reach a dangerous temperature. The active element of this device (Fig. 4) consists of a bulb connected by a copper tube to a copper bellows. The bulb contains a volatile fluid which boils at a temperature considered as dangerous to the bearing metal. The resultant expansion of the vapor forces the bellows open thus tripping a toggle switch (Fig. 5).

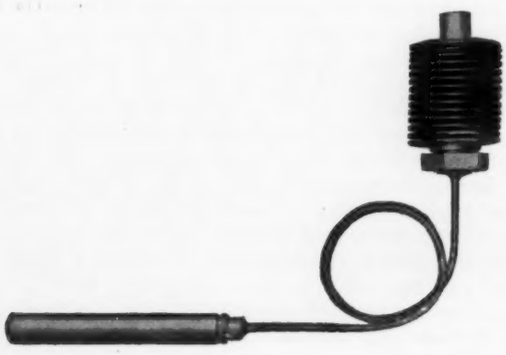

FIG. 4.

core of the ratio coil is made small so as to saturate readily. Above the coil is the oil filled thermal element. Inside the container is an assembly of spiral bi-metal springs their inner ends mounted on a vertical shaft, their outer ends anchored to the housings. Through these springs is carried the current from the ratio coil. The springs are immersed in oil which absorbs the heat liberated by the current passing through them. The container has a jacket to retard the radiation from the outer walls. The relay is adjusted so that the input is just equal to the radiation at full load. The vertical shaft carries a moving contact. The stationary contact is adjustable from the top to enable accurate adjustment of the time of operation. When the input exceeds the radiating ability of the jacket, the temperature of the oil rises and the bi-metal

FIG. 5.

springs cause the shaft to rotate thus closing the contacts. This relay actually may be said to measure the root-mean-square value of the current input to the machine.

It is very essential that the maintenance crew be promptly advised as to the cause of any trouble in the apparatus. It is also necessary that the automatic

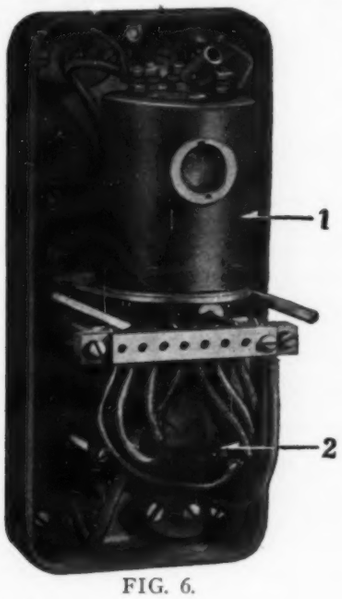

FIG. 6.

control be locked out of service should certain troubles occur. A lockout relay (Fig. 7), combines these desirable functions. This relay has a manually reset magnetically tripped trigger. The trip circuits come in through individual annunciator drops. On the relay shown, the left drop indicates operation of the a.c.

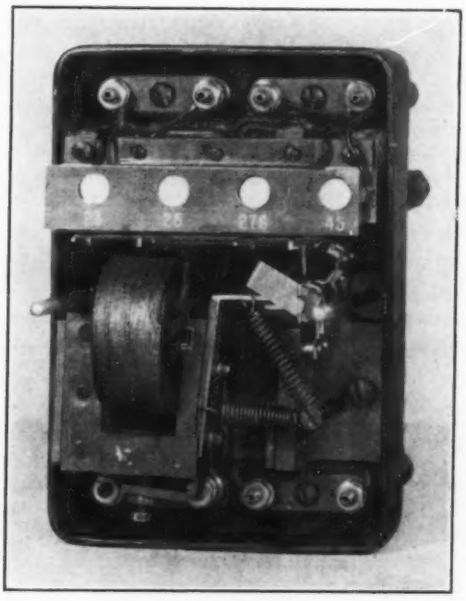

FIG. 7.

short circuit relays, the next, the operation of a bearing thermostat, the next drop indicates the operation of a time relay which starts when the starting switch connects the machine to the starting taps. Should the machine fail to transfer to running position within a given time, the lockout is operated to save the auto transformers from destruction. The fourth indicator shows open phase trouble within the station, usually a contact burnt off the starting switch.

To illustrate the extent to which automatic devices have been developed, I am showing you an illustration of a short circuit detector type of Railway Feeder Panel. This panel does many things that no operator, no matter how intelligent, can hope to equal. The contactor on this panel will open on a short circuit even though quite distant from the station while

FIG. 8.

it will not open on a heavy overload quite close to the station even though the overload rise to a value several times that of the short circuit. The trick is quite simple. A standard slip over current transformer with the magnetic circuit opened slightly to prevent saturation is put on the outgoing feeder. Changes of current value incident to normal or abnormal movement of cars are relatively slow while a short circuit causes a very rapid rise in current. The quick change induces

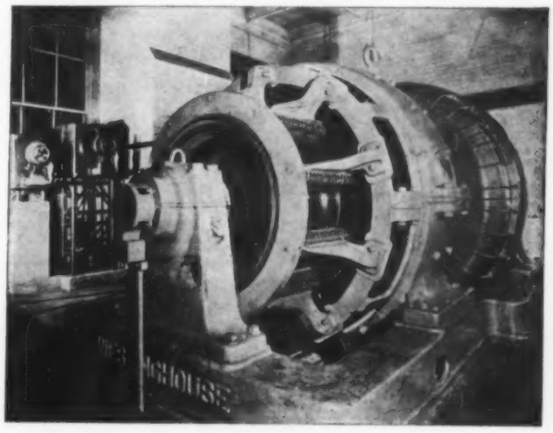

FIG. 9.

enough current in the transformer secondary to trip a relay which the slow changes, even though they be of much greater final value, do not induce sufficient current to trip the relay. Can you hire an operator who will exercise such discretion?

Not content with this remarkable performance the feeder next connects up a Wheatstone bridge and measures the circuit resistance. When this has risen enough to indicate that the circuit is clear the feeder recloses.

One of the first large automatic sub-stations to be put into industrial service was for the Packard Motor Car Company at Detroit. The machine is a 1500-kw. synchronous motor generator set with 4,600-volt, 3-phase, 60-cycle motor. The generator feeds a 240-volt, 2-wire factory bus (Fig. 9). The switching equipment is very similar to those which will be installed in the Edgar Thompson Plant. The point of principle interest in the control is the regulator which has three elements, all controlling the generator field rheostat which is motor driven. The first element functions during starting by balancing the voltage of the generator with that of the bus. When a balance is reached the d.c. breakers are closed. The second element then regulates for a given voltage. The third element steps in when the load exceeds that allowable and reduces the generator voltage.

The automatic protection of rotating machinery has been carried to a high degree of excellence as may be seen by the above examples. We are approaching the problem of the design of automatic control for steel mill service with full confidence that not only can we duplicate the best results obtained with operators but can actually do better. On one large traction system, a careful analysis of maintenance costs actually showed that the cost per kw. of installed capacity for maintaining the automatic stations was less than that of the manual stations. Human failures causing expensive damage was the explanation. The automatic stations made no operating mistakes.

The automatic control system worries not if it works 8 hours or 12, never goes on strike for higher wages and does not respond to radical agitators. In other words it is the solution to a problem for which we have been seeking an answer for many years. More such automatic devices saving in high priced labor will cut costs so that we can retain our industrial leadership and compete with foreign countries where labor, while of poor quality, is so cheap that it is difficult to compete with.

DISCUSSION

E. Friedlander:* The 8-hour day and subsequent higher cost of labor are liable to increase the price of steel products to such an extent, that foreign competition will take away business, which by right belongs to our country.

We electrical engineers, more than anybody else in the iron and steel industry, can be of great assistance in reducing this cost of labor through introduction of labor saving machinery and devices.

There are a great number of men employed to merely watch machinery perform its work; their main duty is to start same when needed and shut it down in case of trouble or when not needed.

These men are in most cases unskilled and cannot locate or remedy faults or troubles, but depend on skilled men to do this work, causing serious interruption to service.

Often through negligence, inexperience or carelessness of attendant, serious delay and damage to apparatus is caused.

The introduction of automatic operation of generators, motors, pumps, fans, etc., will not alone show a great saving of wages for operators, but time of interruption to service will be greatly reduced, also cost of repairs of machinery.

To predict that soon not alone individual motors driving rolls, pumps, fans, etc., will be started and stopped by means of push-buttons from the distance, but power houses or substations will be entirely and successfully operated automatically, thus eliminating all attendants.

Location of such installations can be chosen at center of power distribution without consideration of cost of operation or labor.

The roller will start his mill by means of push-button from the pulpit much quicker that he has heretofore by signalling the attendant to start motors.

Bearings are oiled by means of oil-rings or pressure supply and fully protected by thermostat relays, also windings of motor, in such a manner that in case of trouble, alarm will first be given and if not relieved after a given time (say 30 seconds) motor will shut down.

Over-load, over-speed, field-failure, etc., can be taken care of by means of relays.

Our subject tonight is the automatic operation of sub-stations for steel mill service. In designing the necessary equipment, the aim is to duplicate by means of the least number of pieces of reliable apparatus, the various operations, that a sub-station attendant performs.

No mistakes can be made in switching, as each individual piece of apparatus is so interlocked with the rest of the apparatus in the station, that one operation must be carried out before the next one can take place.

Refinements are being made rapidly to simplify automatic operation. Unusually complete protective devices safe-guard the apparatus from injury wherever faults arrive outside or inside of station and at the same time assure the least interruption to service.

Where two or more units are operating in one station, additional units can be started automatically, whenever load demand requires it, by means of load relays. Time relays will again shut down units after a certain time, if load falls off.

Stations can be started from any point either by means of push-buttons, time clock or load demand relays.

Provision can be made to take care of any kind of trouble that might arise in a sub-station as for instance against

(1) A.C. supply interruption.
(2) A.C. overload.
(3) D.C. overload.
(4) Overspeed.
(5) Single phase starting.
(6) Hot windings.
(7) Hot bearings.
(8) Hot resistance.
(9) Loss of field.
(10) Wrong polarity.
(11) Phase reversed in supply line.
(12) Low voltage in supply line.
(13) Reverse power.
(14) Dirt or dust causing apparatus to function improperly.

*Electrical Superintendent, Carnegie Steel Company, Braddock, Pa.

All these abnormal conditions can be guarded against fully without fail.

One operator can from a central location supervise by means of automatic telephone selector relay system, any number of sub-stations miles away; start and stop any units by means of push-buttons and check by means of signal lamps the proper operation of all apparatus. Often one or not more than three wires are required to start each unit. A small infinitesimal pulsating current actuates the first relay, which in turn through interlocking starts the next operation.

J. J. Booth:* I would like to make a few remarks in regard to the equipment we hope to install in this plant. We have in our No. 1 sub-station two 1,000 k.w. motor generator sets operated by 1440 hp. synchronous motors fed by two 3-phase, 25-cycle, 6600-volt lines. In this particular station we have three 500 K.v.a. transformers operated from the same lines. These transformers supply power for the a.c. motors in open hearth plant, the blooming mill and No. 2 mill. If we happen to lose our a.c. power, it has always been our practice to have our operators invert one motor-generator set and supply a.c. power to keep open hearth gas producers going and also to avoid as far as possible the cobbling of steel in the mills. These relays which have been shown on the screen tonight are for the same purpose. In other words, if we lose a.c. power, we expect one machine to automatically invert and within less than seven seconds supply a.c. power, and in this way we hope to cut down the cobbling of steel in No. 2 mill and blooming mill.

In our open hearth department, No. 2 sub-station, we have one 1000 k.w. motor generator set of the same characteristics, as machines in our No. 1 sub-station. Our No. 3 sub-station or furnace sub-station, we have two 1000 k.w. motor-generator sets of a slightly different design. At No. 2 sub-station we are supplying power with one line only. At Nos. 1 and 3 sub-stations we are supplying power with two lines to each station, and have agreed to keep power on each line at all times unless one of the lines is in trouble.

The equipment in the respective sub-stations will be full automatic and will provide for the automatic starting of machines by load demand and automatic stopping by the use of under-load relays. Pull button switches will be provided for starting and stopping all machines from power house.

Also, arrangements will be made at power house for load indication on each respective sub-station.

When we were contemplating buying the equipment, we figured on eliminating two operators at each sub-station, or a total of six operators. But since placing the contract for this equipment, the eight-hour day has come into vogue, and we will eliminate nine operators. This does not mean, however, that we do not intend to keep stations clean and have systematic inspection of equipment, as there will be one man assigned to this duty, working eight hours per day, and with this practice we will really only eliminate eight men.

With the full automatic equipment as above described we hope to eliminate nine operators as stated, operate machines at higher load factor, increased economy, and with greater reliability than was the case with the manually operated stations.

Chester Lichtenberg†: Mr. Wensley has given you a very good picture of the various devices used and functions which they perform in automatic switching equipment. By some curious coincidence—probably because the same problems are to be met—all of the companies who manufacture automatic switching equipment supply similar protective features for the same classes of service. The devices manufactured by one company, as well as the manner in which they are interconnected to perform a given set of functions, will, however, differ from those manufactured by another company. So that while two equipments will give performances which are similar, the appearance of the equipments and probably their operation will be somewhat different.

It might interest you now, after having seen some of the devices used in the various types of automatic station service, to learn a little about how the industry started to develop and to supply automatic switching equipment. A far-seeing man, president of the Detroit Edison Company, Mr. Alexander Dow, in 1911, conceived the idea of having non-attended substations on his Edison network. He had tried limiting the amount of direct current furnished to that network, but was unable and as more and more customers demanded direct current service he found it necessary to add additional substations. These substations were relatively small in capacity; i.e., 500 kw., and the amount of energy they supplied did not warrant operators. They would have been uneconomical if operators were necessary so Mr. Dow came to the General Electric Company and asked if they could furnish to him a substation equipment which could be controlled from a nearby substation. The manufacturer's engineers studied the problem and designed an equipment which was placed in operation in 1913. It was the advance-guard of the automatic substation of today—a 500 kw. synchronous converter operated from 60 cycle supply circuits of the Detroit Edison Company. It was followed by four others which were located in the center of the city one in the Detroit News building, one in the Hotel Statler and several more in the immediate vicinity.

About two years later, one of the engineers attached to the Chicago office of the General Electric Company, and who had been concerned with the first electric steel mill drive at Gary, Ind., conceived the idea of going one step further and making substations load responsive starting and load responsive stopping. In other words, he took Mr. Alexander Dow's substation idea and equipped it with load responsive relays, so that when the voltage dropped below a predetermined point the station started up, placed itself in circuit between the a.c. supply and the d.c. network and furnished power to the d.c. network. He provided this equipment with an underload relay which shut it down if the load on the station dropped below a predetermined amount. He developed and placed in operation on the Elgin & Belvidere Electric Railroad, December 25, 1915, the first automatic substation of which we have record and it is operating today. Later it was supplemented by two others, and now these three 300 kw. automatic substations are the sole source of power for this 35 mile railroad. The Railroad

*Electrical Engineer, Carnegie Steel Company, Braddock, Pa.
†Electrical Engineer, General Electric Company.

company formerly had seven substation operators, two per station and one relief man. Now they have one man who takes care of the three stations, winds the armature of the railway motors and has time to get sick. I went up there in May, 1920, and found a very dirty condition in the two outlying stations. The man in charge said, "I haven't been to them since last Christmas just before I took sick." So that for five months he had not inspected those substations yet they were operating and running the railroad.

From that starting point in 1915 the automatic substations have developed until they cover practically every condition encountered in every industry, with the single exception of steam turbines. We have quoted on several steam turbine installations but nobody seems to want to be the pioneer.

The usual applications to synchronous converters, motor generators and hydro-electric generators are quite familiar to all of you. The control of synchronous condensers and four unit balancers applied to operate passenger elevator motors may not be so familiar. These have been successfully made automatic and require only an inspector about once a week.

The first automatic synchronous condenser I have knowledge of was started just before war was declared in 1917. In fact, the chap who developed it and put it into operation was called into the Naval Service in May, 1917. The next time he looked at it was in 1921. It had been maintained by inspectors who knew very little about electrical apparatus yet it continued to perform with marked success. There is an amusing story in connection with this automatic condenser. It was shut down one day for an inspection and it stayed shut down a whole day. Some time after it had been stopped the manager of the steam station was approached by a delegation who said they could not keep up steam. There was more power to be furnished because this synchronous condenser was down.

Another unique illustration which I think will be of interest to steel mill men because the character of the load is almost the same as encountered in steel mill practice. This is a 2,000 kw. automatic synchronous motor generator in the 110th Street Station of the New York Central Railroad. The equipment starts from rest and carries full load in 30 seconds. It is so arranged that it will carry 150 per cent normal load for two hours. If the load is continued beyond this time a little scheme is automatically operated which cuts the load down to normal. The normal current of the set is 3000 amperes. I have seen it go up to 7000 amperes direct and down to 5000 amperes reverse and yet the set stay right on the line. The fluctuations are wide and rapid and caused by heavy locomotives dragging long trains starting simultaneously. This 2000 kw. motor generator set with automatic control has been known to supply 7000 kw. for brief intervals.

Another example of the overload abilities of the automatic is on the Chicago, Aurora & Elgin Railroad. Here a 300 kw. converter takes care of fluctuations at least three times normal without any difficulty.

The load fluctuations on these electrified steam railroads very nearly approximate the conditions encountered in steel mill operation and the designs we propose follow the equipments now performing successfully in the most arduous railroad service.

The General Electric Company's automatic stations incorporate many features with which all steel mill engineers are familiar. They use steel mill contactors wherever possible and only resort to relays where they need a device of instrument precision.

Another feature lightly touched by Mr. Wensley might be emphasized, I do not know how far, though, we would advocate them for steel mill service. We have developed and have had in operation for several years schemes for distant electric control of all sorts of apparatus. The New York Edison Company is doing all its dispatching with a few pairs of telephone wires rented from a local telephone company and in operation between all of their stations and their dispatcher's office. The Malden Electric Company is doing the same thing, and a number of railway companies are starting to take up this system of distant control and indication.

In concluding, permit me to congratulate the Edgar Thompson Steel Works management and Mr. Friedlander for being pioneers in automatic switching equipment for steel mill service.

A. C. Cummins:* After hearing such a thorough, concise, and complete statement of the case of the automatic substation by one who is so capable of handling the subject as the author of the evening, I do not feel able to add much to what has already been said. We are fortunate in having such a paper presented for the consideration of our membership. It has just occurred to me that if the performance of the various types of relays that have been described are to be relied upon, it will not be long until automatic cranes will eliminate crane operators. When you hear of wireless control of battleships, and then of the automatic devices which almost think, developed for the control of electrical machinery, it seems only an additional step to combine a microphone, some amplifiers, and a few relays to secure crane control which would respond to vocal signals; in other words, could be talked to. Were such a combination of apparatus possible, it would save the superintendents of the steel mill electrical departments many calls on the phone when cranes are supplied as at present with a large number of inexperienced operators. I would like to ask the author if he feels such a device will ever become practical.

It has been said that the automatic substation offers more in the way of continuity of power supply in industrial plants than it does in the way of saving in labor. I thoroughly agree with this statement. In all mills there are a certain number of employees who have rendered faithful service for long periods and have become unable to perform tasks requiring much physical effort. Substations offer an almost ideal location for keeping such men employed, and it is my opinion that if we take them out of the substation because automatic equipment is installed, the cost of their employment will not be saved because they will generally be placed in some other location where their actual earning power for their employers is practically nothing. In addition, there is no question that the installation of automatic substations will mean the em-

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ployment of a certain number of highly skilled electricians. My personal experience has been that the supply of such men is very limited, and that they usually must be enticed to the mills from the central station field, and the remuneration must be high. With these points taken into consideration, I doubt if the actual saving in money on account of the reduced labor will be so great as is anticipated, in the proposed installation at the Edgar Thomson Works.

As to the value of the automatic substation as a means of lessening service interruptions, there is no question. Automatic relays, when functioning properly, are so rapid in their operation, that interruptions are restored so quickly as compared to the interruptions occurring in manual control as to greatly lessen their importance from an operating standpoint or from a safety standpoint. It is entirely possible to believe that the automatic substation will resume service after momentary interruption of the a.c. supply so rapidly that steel on mill tables can be rolled without cobbles, and that the hazard to men handling hot metal in the open hearths is materially lessened by such equipment. In many plants, ingots are poured by moving the crane from one mold to the next, and if the stopper valve in the ladle is not tight, an interruption of the power supply means a lot of steel on the floor and the chance of someone being burned.

In closing, my one suggestion is that every possible effort to simplify the control of this automatic equipment be used. Skilled electrical labor in the steel industry is not as plentiful now as it was 10 years ago in proportion to the amount of complicated apparatus that is installed. In a great many places, all skilled men must be made by being trained in the plant organization, and if automatic control becomes so complicated as to require greater and greater numbers of skilled men more rapidly than they can be trained, some steel mill engineers may hesitate to make such installations. I had a discussion with the chief engineer of one of the largest control manufacturers a few days ago and in the course of the discussion he stated that he had recently inspected some control apparatus in a large steel mill and was surprised to find that there were very few magnetic controllers on which all the relays were functioning as their designer intended. If we have trouble in maintaining the operation of magnetic control relays at 100 per cent reliability, are we not likely to have more trouble with the more complicated switchboard type of relays required for the automatic substation? I think the manufacturers should give this matter some thought and that every effort should be made to make their relay equipment rugged, easy to adjust, and simple to repair.

W. T. Snyder*: I was very much interested in the description of the automatic sub-station as given by Mr. Wensley. With the automatic station we have had no experience, but have had in operation since 1916, remote controlled sub-stations. We have a plant at McKeesport, approximately 1½ miles long by one-fourth mile wide—a long narrow plant. At the east end of the plant we have a low pressure power plant. In the center of the plant we have a high pressure turbine generator power plant. In 1916 we moved a motor generator to the west end of the plant and made it remote controlled from the main power plant in the center of the property. About 1918, we installed two more remote controlled sub-stations; one between the west end sub-station and the main plant the other midway, approximately, between the two power plants. One of those sub-stations—the first installed—contains 1000 k.w. motor generator set. Of the next two sub-stations installed, one contains two 1500 k.w. motor generators running in parallel, remote controlled from the main power plant; the other contains one 1500 k.w. motor generator set. All three sub-stations running without operators. An attendant from main power plant makes a trip under the old schedule once every 12-hour turn, now once each 8-hour turn. Our experience with these remote controlled sub-stations has been altogether satisfactory. We have had no mishaps in a sub-station that we could not expect to have with an attendant present. We would not hesitate to install more of the same kind, even at greater distance. I will not go into further details, but at the Baltimore convention in 1918, a paper was delivered giving details of the stations then operating. This paper was published in the 1918 proceedings of the Association.

J. S. O'Donovan†: I haven't very much to offer. We are rather unfortunate in having two sub-stations which it would be almost impossible to run without operators. The saving of a man would not be as much as the saving of time in switching. I think that the future sub-stations, as well as the main station, should be automatically connected with feeders, and feeder work throughout the mill should be automatic. I think there is a big field throughout the industry, and especially in the steel mill, to work along the line of more prompt attention to shut-downs and interrupted service, by the use of automatic switching.

O. H. Needham‡: It has been very interesting to hear Mr. Wensley describe this apparatus and tell what it has done and what it can do. I feel that the day of automatic sub-stations in steel mills has arrived. This equipment has been thoroughly tried out in railway, mining and other industrial plants so that there should no longer be any doubt as to its reliability. There will, no doubt, be some sub-stations in which it will not be advantageous to install automatic equipment, but, on the other hand, there is a large number in which automatic equipment can profitably be installed, and no doubt will be installed within the next few years. It is simply a question of picking out the places for automatic sub-stations and going ahead. They are no longer experimental, so it is a question of good engineering as to whether they should be automatic or manual.

E. Friedlaender: One of the reasons we are making our sub-stations full automatic is to increase load factor. I would like to ask Mr. Snyder what load factor he is getting on his remote controlled sub-stations. I think we could increase load factor in our power house if we had some means to start and stop prime movers automatically when necessary and not depend on attendants. It may look today impossible to do this automatically, but I do not think we are very far away from it. The load factor in steel mill power

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†Elec. Supt., Spang Chalfant Company, Etna, Pa.

‡General Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

houses is from 50 to 75; above 75 only very rarely, in sub-stations even lower. I would like to ask Mr. Wensley or Mr. Lichtenburg what they have accomplished in load factor improvement.

W. T. Snyder: Our conditions, I believe, are somewhat different from conditions at Edgar Thomson Works. Extending the length of the plant we have a heavy d.c. line, practically a d.c. bus. The sub-stations all feed into this d.c. bus in parallel. The operator in main power plant controls the load on any machine. As the load varies, he can shut down the machine or transfer the load from one machine to another. At the finishing end of the plant we have fairly constant load and maintain fairly high load factor. At the lower end where we have blooming mills, fluctuating loads, the load factor is not quite so high. The load can be varied by control wires running to sub-stations.

Chester Lichtenberg: We have at least eight systems completely automatic where load factor has been increased. They are at Des Moines, on the Chicago, North Shore & Milwaukee Railroad, on the Chicago, Aurora & Elgin, on the Pacific Electric Railway, on the Iowa Railway & Light Company, on the City Railway of Los Angeles and on the New York Central Railroad. In designing these systems we have taken advantage of the overload characteristics of the machines. Almost every motor generator or synchronous converter can maintain for a half minute a load considerably in excess of normal. Sometimes as much as three or four times normal. So if you have two motor generators or converters in a station you can have the first carrying more than double its load during the half minute it takes to put the second in line. Des Moines had 14 automatic sub-stations and one manual. By suitable adjustment of the relays we have been able to select those sub-stations necessary during 24-hour period. The same thing is being done on the other systems so that we know we are able to increase load factor by purely and completely automatic control.

I understand this same subject has been brought up before the Electric Railway Association. Cleveland maintains they must have supervisory control to get the best load factor out of their equipment. St. Louis maintains that purely automatic control gives them best satisfaction. I am inclined to favor St. Louis, partly because of their equipment, and partly because they have adopted the right attitude by putting in single unit stations. At Cleveland they have adopted double unit stations and I think they regret it. Hence the characteristics of these two systems are absolutely different. Cleveland requires supervisory control St. Louis don't need it.

We have still another situation at Kansas City where they have put in several banks of transformers in each of two sub-stations and only use as many banks as they require for the load. They have even gone a step further. They have three high tension cables going into each of these automatic feeder stations and they use only one or two or three as the case may be. The automatic increases the load factor on these various equipments.

We have had any number of cases mentioned in A.I.E.E. and A.E.R.A. proceedings where automatic stations have been claimed to have a higher load factor than manual substations.

Another point is in regard to complication. These automatic sub-stations are not complicated. Most of you know the average mine electrician is not as high grade as those in charge of steel mill operations. The mine electrical departments are usually small. Often in a steel mill you will have as many men employed in the electrical department alone as there are employees in the mine. However, our experience has been that we can send an automatic sub-station to a mine and the mine electrician can install and operate it successfully, making all the necessary adjustments on the relays. The few adjustments which are necessary are plainly given in the Instruction Book, and very seldom do we need to send an engineer to help adjust stations.

E. Friedlaender: Are these stations you mention adjusted so they can be overloaded? Presumably we can overload our stations.

C. Lichtenberg: It has field control. On a normally 3000 ampere station, I have seen 7000 amperes positive and 5000 amperes negative.

R. J. Wensley: That problem of load factor came up in connection with the big installation of railway equipment at Cleveland, and the answer to it was this centralized control that was installed. It is rather difficult to get the load factor on the automatic stations to a high point when operating under purely automatic control. If you have a set program and have a big switch to cut stations out, it will help some, but that is not possible, usually, in steel mill work, because demands are unexpected or severe so that some form, or centralized form of control will be necessary to keep load factor where it belongs. At Cleveland they use this to lock out machines in remote stations that are not needed to maintain service. They allow the service in that particular department to be slightly penalized by momentary low voltage by starting of cars at night and keep stations out. In that manner they brought system load factor up decidedly by keeping the number of machines operating down. With purely automatic control that will be hard to do. There are possibilities of cutting out machines not loaded and quickly starting them again. Usually in steel mill work it will be necessary to keep enough capacity on the bus to take care of the largest units that are liable to be starting at that time, and unless we provide some means whereby the foreman of the rolls can indicate to the sub-station, any departments where he will be starting, I do not know what we can do. A good deal of development work along that line is needed, and we have not done possibly as much as we should have done in regard to shutting down and keeping out of service, stations not needed. However, developments have not stopped and we may arrive at a solution some day.

P. S.—As the subject of Automatic Substations is an interesting one to those connected with the iron and steel industry, we will gladly print any additional discussion which our readers may care to offer. This data which is sent in from time to time will appear in the current issues of the Iron and Steel Engineer.

Program of Papers and Meetings for District Sections of the A. I. & S. E. E.

Philadelphia Section

Officers and Committees—1923-24

Chairman—W. H. Burr.
Past Chairman—W. C. Kennedy.
Vice Chairman—P. T. Vanderwaart.

Executive Committee—W. H. Burr, chairman; P. T. Vanderwaart, W. C. Kennedy, F. H. Woodhull, George Pfeffer.

Papers Committee—H. S. Boone, chairman; A. J. Standing, J. R. Penman, F. O. Schnure, J. R. Bower.

Meetings Committee—B. T. Hare, chairman; T. E. Gallagher, C. H. Williams, C. J. Maloney, A. B. Coffman.

Reception Committee—George H. Schaeffer, chairman; L. R. Humpton, H. D. Esterly, H. G. Nichols, E. D. Sibley.

Membership and Attendance Committee—D. M. Petty, chairman; James E. Wilson, H. N. Lucas, R. F. Gale, G. W. C. Frey.

Representatives to the Engineers' Club—Board of Directors, Linn O. Morrow; Meetings Committee, John C. Reed; Publications Committee, David Smith; Research Committee, H. A. Lewis.

Secretary—Linn O. Morrow, Franklin Trust Building, Philadelphia, Pa.

Meetings and Papers

Saturday, January 5, 1924—

"Anti-Friction Bearings," "Design and Application of Ball Bearings to Electric Motors," T. C. De Laval Crow, Chief Engineer, The New Departure Manufacturing Company, Bristol, Conn.

"Mounting and Maintenance of Roller Bearings in Electric Motors," W. B. Wachtler, Manager Eastern Division, Hyatt Roller Bearing Company, Newark, N. J.

Saturday, February 2, 1924—

"Steel Mill Electrical Machinery and the Insulation Problem," C. E. Skinner, Assistant Director of Engineering, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Saturday, March 1, 1924—

"Effects of Heavy Short Circuit Currents on Bus Structures," P. T. Vanderwaart, Electrical Engineer, the New Jersey Zinc Company, Palmerton, Pa.

Saturday, April 5, 1924—

General Ideas and Discussion. Every Active Member is invited to prepare a short paper on a subject pertaining to the application of electricity to the iron and steel industry.

Friday, May 2, and Saturday, May 3, 1924—

Harrisburg Meeting, Harrisburg, Pa.

"Decisions of the Public Service Commission Relative to Rates of Electric Light and Power Companies," Dr. F. Herbert Snow, Chief, Bureau of Engineering, Public Service Commission of the Commonwealth of Pennsylvania.

Inspection trips to the Steelton Plant of Bethlehem Steel Company, Harrisburg plants of the Central Iron & Steel Company and Harrisburg Pipe & Pipe Bending Company, Middletown plant of the Metropolitan Edison Company under construction.

Announcement of the results of the election of officers for the coming season.

Saturday, June 7, 1924—

Annual Outing. Details will be announced at the May meeting.

All meetings, unless otherwise noted, will be held in the Engineers' Club, 1317 Spruce Street, and will start promptly at 8 P. M. They will be preceded by an informal dinner at 6 P. M.

The privileges of the Engineers' Club are at the disposal of the members on the day of the meeting. Make the club your headquarters. Attend every meeting and bring your friends.

Pittsburgh Section

Officers and Committees—1923-24

Chairman—J. J. Booth.
Past Chariman—R. H. Keil.
Vice Chairman—R. E. Lewis.
Secretary—J. F. Kelly.
Assistant Secretary and Treasurer—T. Moffitt.

Executive Committee—J. J. Booth, chairman; R. H. Keil, R. E. Lewis, J. H. Barker, H. C. Mosley, J. F. Kelly, T. Moffitt.

Papers Committee—R. E. Lewis, chairman.

Meetings Committee—W. C. McKibben, chairman.

Membership Committee—R. M. Hussey, chairman.

Entertainment Committee—E. W. Harry, chairman.

Meetings and Papers

January 19, 1924—

Topical discussion, "Ball and Roller Bearings," by designing engineers of the Rollway Bearing Company and SKF Industries, Inc.

February 16, 1924—

"Recent Electrical Developments with Particular Reference to the Fynn-Weichsel Motor."

March 15, 1924—

"Diseases of Steel Mill Motors," E. Friedlaender and J. J. Booth.

April 19, 1924—

Topical discussion, "Trucks for Steel Mills."

May 17, 1924—

Inspection Trip. (Prominent steel strip plant.)

June 21, 1924—

Inspection Trip. (Via boat. One of the largest steel plants in the world; also one of the largest by-product coke plants in the world.)

Chicago Section

Officers and Committees—1923-24

Chairman—Henry Davis.
Vice Chairman—R. L. McIntosh.
Committeeman—W. S. Hall.
Committeeman—Gordon Fox.

Attendance Committee—C. W. Donovan, chairman; F. A. Wiley, C. J. Smith, V. A. Bloxham, W. D. Cameron, F. L. Collins, A. R. Dibbens, R. E. Boehler, E. C. Otto, F. J. Burd.

Entertainment Committee—B. G. Beck, chairman; R. O. Herbig, T. P. McGinnis, L. M. Gumm.

Reception Committee—Gordon Fox, chairman; O. M. Bercaw, L. M. Gumm, G. H. Lounsbery, E. C. Otto.

Meetings and Papers

January 11, 1924—

Mr. D. E. Batesole, M.E., of the Norma Company, will present a paper on "Roller Bearings," and Mr. E. R. Carter of the Fafnir Bearing Company will present a paper on "Ball Bearings."

February 15, 1924—

Mr. Dwight D. Miller of the Milwaukee Electric Railway, Light & Power Company will have something interesting to offer us on the subject of "Electric Furnaces and Electric Heating in General." Mr. Miller has made quite a study of this subject and his position with the Milwaukee Lines is to go around to various consumers and talk on that subject.

On the same date we expect to have a paper on the "Industrial Electric Locomotive" by an engineer of the Goodman Manufacturing Company.

March 14, 1924—

Mr. G. R. McDermott of South Works of the Illinois Steel Company has promised to give us a lecture on "Combustion."

April 18, 1924—

Mr. Jamieson, one of the engineers of the Commonwealth Edison Company will present a paper on the "Large Power Stations of the Commonwealth Edison Company."

May 16, 1924—

General ideas and discussions. Every active member is invited to prepare a short paper on a subject pertaining to the application of electricity to the iron and steel industry.

Cleveland Section

Officers and Committees—1923-24

Executive Committee—George R. Roemer, chairman; A. W. Mohrman, vice chairman; A. F. Jones, past chairman; R. E. Scovel, L. W. Long, J. B. Childs, R. S. Sawdey.

Papers Committee—S. L. Henderson, chairman.

Meetings Committee—H. W. Eastwood, chairman.

Membership Committee—C. B. Skelly, chairman.

Secretary—A. R. Lintern, 7960 Lorain Avenue, Cleveland, Ohio.

Meetings and Papers

Monday, January 14, 1924—

Topical discussion, "Ball and Roller Bearings," by designing engineers of two of the leading bearing companies.

Saturday, February 23, 1924—

Annual Dance and "Get-together Meeting."

Monday, March 10, 1924—

"Modern Methods of Crane Lubrication as Applied to Steel Mills," H. E. Thompson, the Richardson-Phoenix Division, S. F. Bowser & Company, Inc., Cleveland, Ohio.

Saturday, April 12, 1924—

"Gas Electric Locomotive and Its Application to Steel Mills," Henri G. Chatain, Engineer, General Electric Company, Erie, Pa.

May—

Inspection Trip.

Birmingham Section

Officers and Committees—1923-24

Executive Committee—W. B. Connally, chairman, Chief Electrician, Gulf States Steel Company, Alabama City, Ala.; F. G. Cutler, vice chairman, Chief of Bureau of Steam Engineering, T. C., I. & R. R. Co., Ensley, Ala.; A. L. Freret, past chairman, Assistant Electrical Engineer, T. C., I. & R. R. Co., Birmingham, Ala.; G. H. Fink, of the Alabama Power Company; J. E. Harrell, of the T. C., I. & R. R. Co.

Secretary—W. W. Garrett, Jr., Engineer of Tests, T. C., I. & R. R. Co., Ensley, Ala.

Papers Committee—L. M. Smith, chairman, Engineering Department, Alabama Power Company, Box 434, Ensley, Ala.; W. H. Beatty, District Manager, E. C. & M. Co., Brown-Marx Bldg., Birmingham, Ala.; A. L. Lemon, General Machinery Company, Brown-Marx Bldg., Birmingham, Ala.

Entertainment Committee—J. E. Harrell, chairman, Chief Electrician, T. C., I. & R. R. Co., Fairfield Works, Fairfield, Ala.; J. H. Adkins, Secretary and Sales Engineer, Shook & Fletcher Supply Company, Birmingham, Ala.; T. L. Bissell, Assistant Commercial Manager, Alabama Power Company, Birmingham, Ala.

Membership and Attendance Committee—M. M. Argo, chairman, Sloss-Sheffield Steel & Iron Company, Birmingham, Ala.; Henry C. Ashmead, Manufacturers' Agent, Brown-Marx Bldg., Birmingham, Ala.; C. W. Burney, Manager Electrical Department, Moore-Handley Hardware Company, Birmingham, Ala.

Pittsburgh Section Inspection Trip, Carnegie Steel Company, Braddock, Pa., October 19, 1923.

R. S. SHOEMAKER

Superintendent of Maintenance, American Rolling Mill Company, Middletown, Ohio, and the Newly Elected President of the A. I. & S. E. E. for the Year 1924

Richard S. Shoemaker, who was elected president of the Association of Iron and Steel Electrical Engineers at its convention in Buffalo, has been associated with the American Rolling Mill Company since 1916, when he became superintendent of maintenance. Mr. Shoemaker is a native of Philadelphia and entered the steel mills early in life. In 1903 he engaged in work connected with the construction of new pipe mills for the National Tube Company of Lorain, Ohio. After the completion of this work he joined Milliken Brothers, Inc., on Staten Island, New York City, in the capacity of electrical engineer, and he had charge of the electrical installation in the Singer Building in 1905-1906. The following year found Mr. Shoemaker in Cleveland with the Electric Controller & Manufacturing Company, where he specialized on the control of steel mill apparatus. Subsequently he became identified with the Pittsburgh Steel Company as chief electrical engineer and later served as electrical engineer of the Algoma Steel Company, Sault Ste. Marie, Ontario, Canada, and with George F. Porter, engineer of construction on the St. Lawrence & Dominion Bridge at Quebec. At the present time Mr. Shoemaker is in complete charge of the mechanical, power and electrical departments at the American Rolling Mill Company's plant at Middletown, Ohio.

R. S. SHOEMAKER

Board of Directors—1924

President—R. S. Shoemaker, American Rolling Mill Company, Middletown, Ohio.

First Vice President—A. C. Cummins, Carnegie Steel Company, Duquesne, Pa.

Second Vice President—G. H. Schaeffer, Carpenter Steel Company, Reading, Pa.

Treasurer—James Farrington, Wheeling Steel Corporation, Steubenville, Ohio.

Past President—R. B. Gerhardt, Bethlehem Steel Company, Sparrows Point, Md.

Past President—W. S. Hall, Illinois Steel Company, South Chicago, Ill.

Director—F. W. Cramer, Bethlehem Steel Company, Johnstown, Pa.

Director—W. C. Kennedy, Worth Steel Company, Claymont, Del.

Director—H. E. Davis, Interstate Iron & Steel Company, Chicago, Ill.

Director—A. F. Jones, Champion Machine & Forging Company, Cleveland, Ohio.

Director—W. M. B. Connally, Gulf States Steel Company, Alabama City, Ala.

National Committeemen

Standardization Committee—F. W. Cramer, chairman.

Papers Committee—S. S. Wales, chairman.

Editing Committee—E. Friedlaender, chairman.

Membership Committee—W. S. Hall, chairman.

Educational Committee—A. C. Cummins, chairman.

Safety Committee—Walter Greenwood, chairman.

Finance Committee—R. B. Gerhardt, chairman.

Combustion Committee—G. R. McDermott, chairman.

Iron and Steel Exposition Committee—J. F. Kelly, chairman.

Convention Reservations Committee—A. C. Cummins, chairman.

Convention Banquet Committee—A. J. Standing, chairman.

R. B. GERHARDT

R. B. GERHARDT

Assistant General Manager, Bethlehem Steel Company, Sparrows Point, Md., and president of the Association of Iron and Steel Electrical Engineers for the year 1923.

Mr. Gerhardt is the one who is directly responsible for the splendid success of the 1923 Iron and Steel Exposition, a pictorial review of which is shown on the succeeding pages.

MILLION DOLLAR SHOW

IRON and STEEL EXPOSITION

Broadway Auditorium, Buffalo, N. Y., September 24-28, 1923

At Buffalo, during the week of September 24th to 28th, 1923, the engineers of the iron and steel industry witnessed the largest and greatest practical demonstration of steel mill apparatus ever assembled under one roof in America.

Fifty thousand square feet of surface were covered with electrical and mechanical devices, most of them being the latest developments of their respective arts, and the 20,000 visitors made the most of their opportunities to examine and question the manufacturers with respect to their product.

From the tiny fuse exhibit to the mammoth foundry exhibit, the engineers wended their ways and made an inspection of all there was to see. The only drawback, as expressed by some, was the limited number of days in which to view the whole show. Some engineers felt that they could have devoted at least two weeks more to making an inspection of the products on hand, for in every booth some new idea was being exploited for the benefit of those men who are responsible for the operating and maintenance of the iron and steel and foundry industries throughout the country.

The display of material handling equipment was probably one of the best ever undertaken and, contrary to the policy of some exhibitors, this particular feature of the show was so good that there were a number of sales actually made on the floor of the show.

Special attention is called to the electric overhead traveling crane which was erected by one of the leading crane builders in the country. This crane performed all the work necessary to operate the modern foundry in actual practice.

A step forward has been made in the elimination of the human factor in material handling by the foresight and aggressiveness of the manufacturers of this class of equipment, and it probably will not be long until the entire industry is completely manned by such labor-saving devices.

The manufacturers of ball and roller bearings were on hand, and a great deal of interest was displayed in their prod-

uct and the data they had. This interest became so general in the bearing question that five technical sessions were scheduled for the month of January, one to be held in Pittsburgh, Philadelphia, Chicago, Cleveland and Birmingham, all under the auspices of this Association and all covering the subject of ball and roller bearings.

One very interesting phase of steel mill engineering was covered by the exhibits of combustion apparatus. A special feature was an exhibit of gas burning apparatus in which was shown a burner which has been developed and indicated a very high percentage of efficiency; apparatus to control the flow of gas and instruments to measure the volume were also shown.

For the benefit of the fuel engineer, there were on display boilers, arches, coal pulverizers, valves, refractories, measuring instruments, flow meters, turbines, superheaters, pumps, and other equipment entering into the question of combustion.

The electrical manufacturers are to be congratulated on their wonderful practical demonstrations of apparatus in motion. These electric manufacturers of today are in a large sense responsible for not only the progress made in steel mill electrification, but much of the advancement and betterment of the human race is in a large sense due to their energy and efforts. The co-operation they extended in being represented at this show was not in vain, for the interest displayed by the steel mill engineers was such as to more than warrant whatever efforts were put forth in preparation for this event.

At the close of the exposition, the engineers departed for their respective steel plants, filled with enthusiasm and ideas gained in conversation and personal contact. The manufacturers hastened to their shops and factories to further add to their improvements, received at the suggestion of the engineers present.

What is the natural result? A lasting benefit to the steel industry in the form of greater production at less cost, with the application of new thoughts and new ideas.

For the engineer who attended the exposition, we are desirous of perpetuating his impressions, and for the engineer who was not fortunate enough to attend the exposition, the following photographic story is produced in the Iron and Steel Engineer so that all who read may learn of the magnitude of the show and the benefits to be attained by attendance at this display.

The exhibitors are deserving of all the praise and co-operation the engineer may extend to them for their part in assisting the steel industry to reach the goal to which all aspire—continuity and economy.

An outstanding feature of the show was the electrified foundry. This feature was an epoch in the annals of this industry inasmuch as a complete and modern in every respect foundry was constructed and operated in one week's time. About 20 manufacturers of foundry apparatus co-operated in helping to make this foundry the success it was. Foundrymen from all over the United States attended this exhibit and witnessed the foundry in successful operation.

Electrified Foundry

Held in Connection With the Iron and Steel Exposition at Buffalo, N. Y., during the Week of September 24 to 28, 1923.

No show, no exhibit, in the United States or Europe, ever was able to completely demonstrate the advantages to be derived from complete electrification until the Association of Iron and Steel Electrical Engineers successfully operated the first and only modern electrified foundry at its Million Dollar Iron and Steel Exposition held in the City of Buffalo during the week of September 24th to 28th, 1923. At this Exposition, castings were actually produced for the market at less money per pound than is possible with most of the foundries in operation today.

The A. I. & S. E. E. was the first society to lay the corner stone for future demonstrations of this character, and the members of this Association may well feel proud that the engineers of the iron and steel industry have again paved the way for the advancement of the application of electricity to one of its closest allies, the foundry industry.

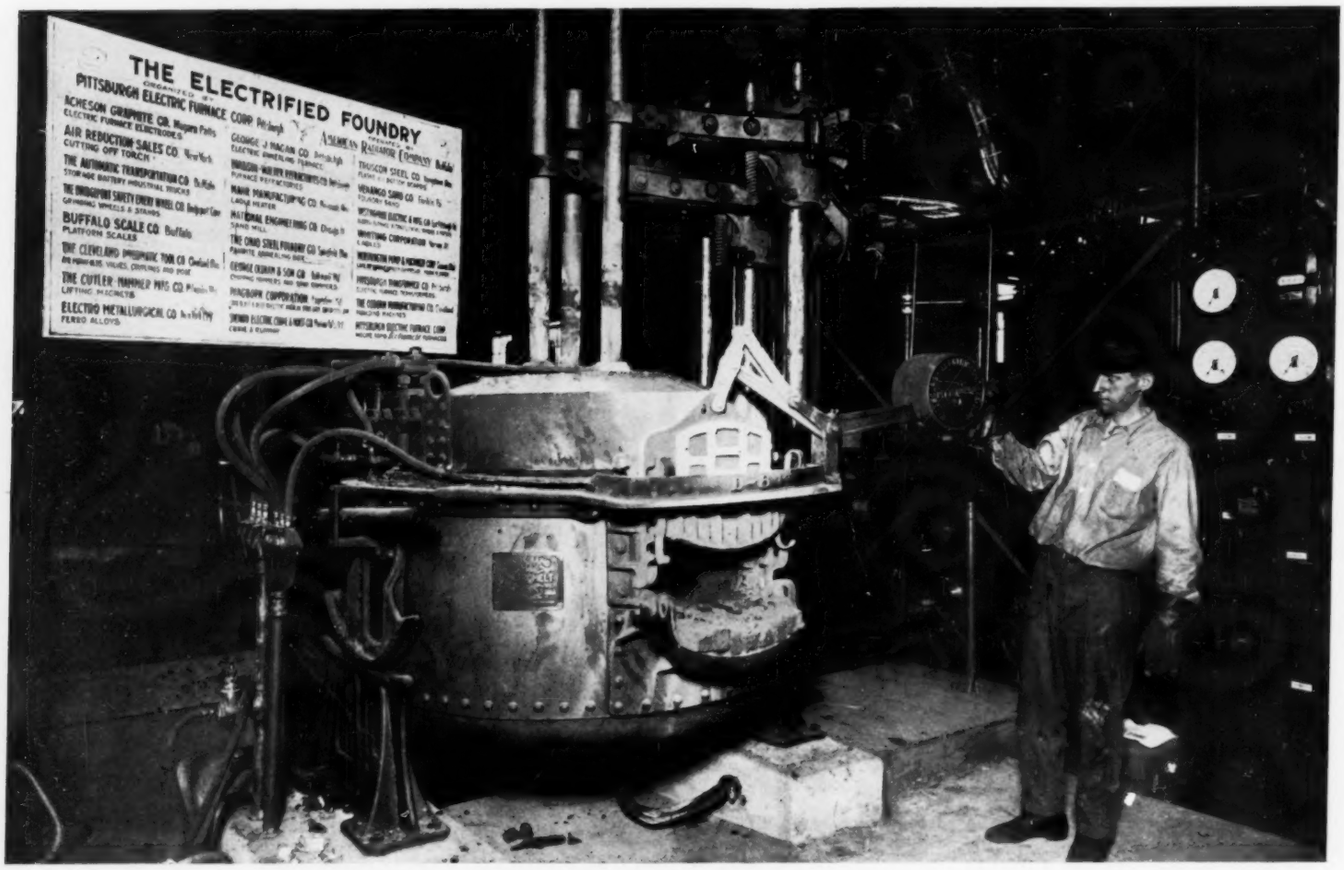
Messrs. W. B. Wallis, E. P. Langworthy and L. W. Egan were the three men prominent during the operation of this foundry, and through their efforts the demonstration was made a success.

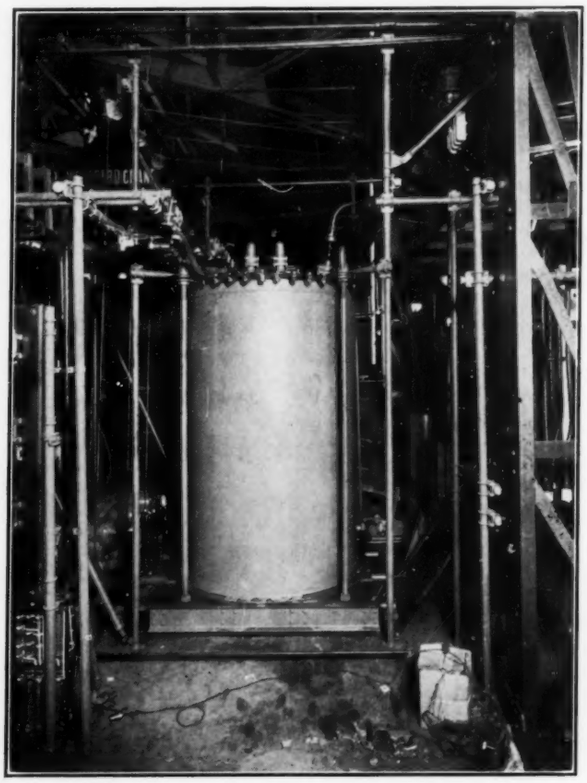
Representative foundrymen from all over the United States attended this feature of the Exposition.

MR. E. P. LANGWORTHY
Manager Arco Steel Plant American Radiator Co. who operated the electrified foundry.

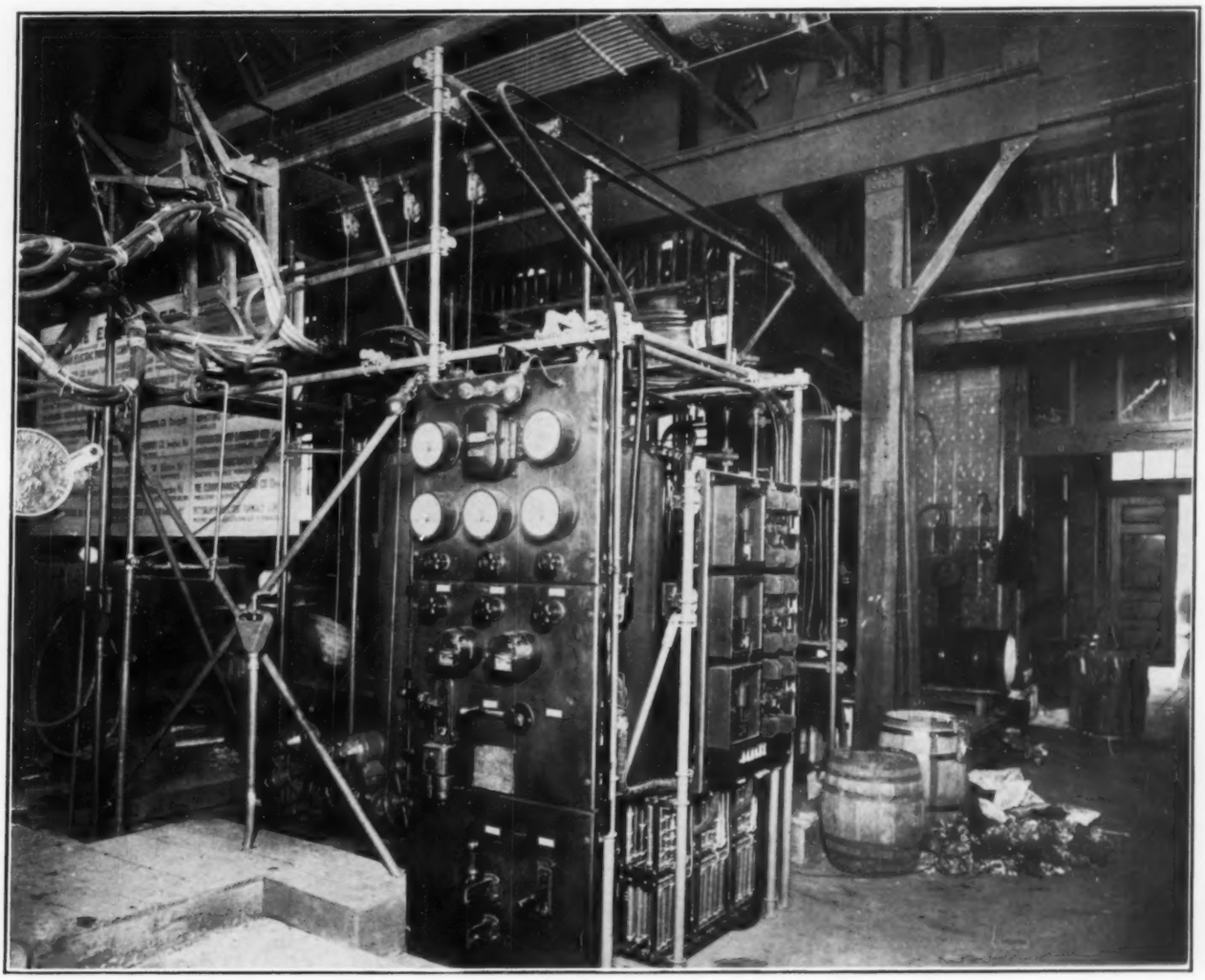
MR. W. B. WALLIS
President Pittsburgh Electric Furnace Corporation who organized the electrified foundry.

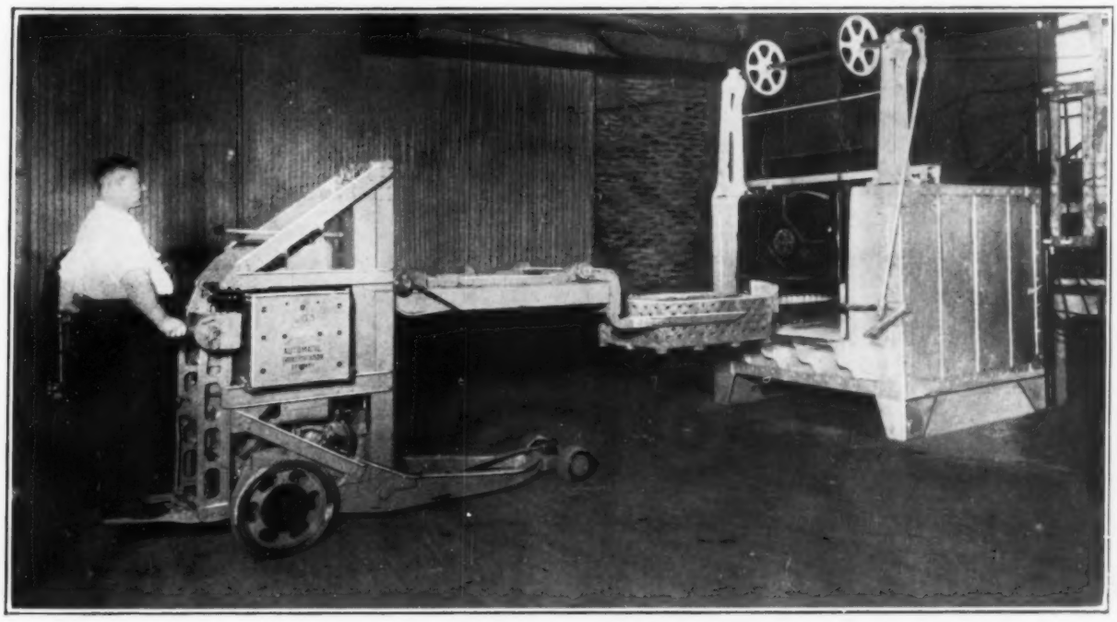
MR. L. W. EGAN
Plant Engineer, Ohio Steel Foundries, Lima, Ohio, who delivered the paper on "The Complete Electrification of the Foundry Industry."



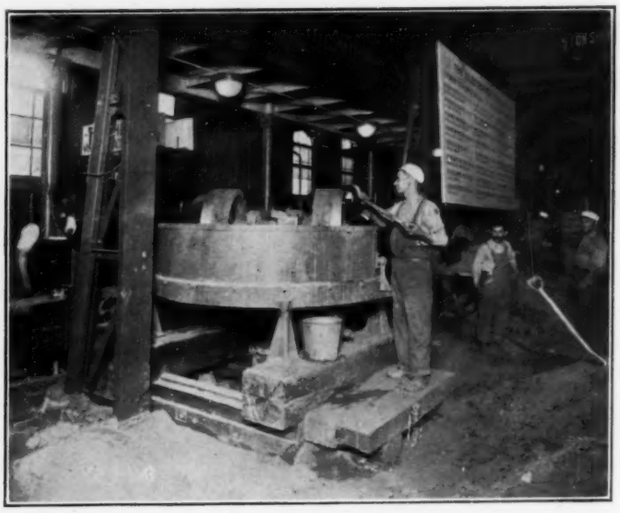


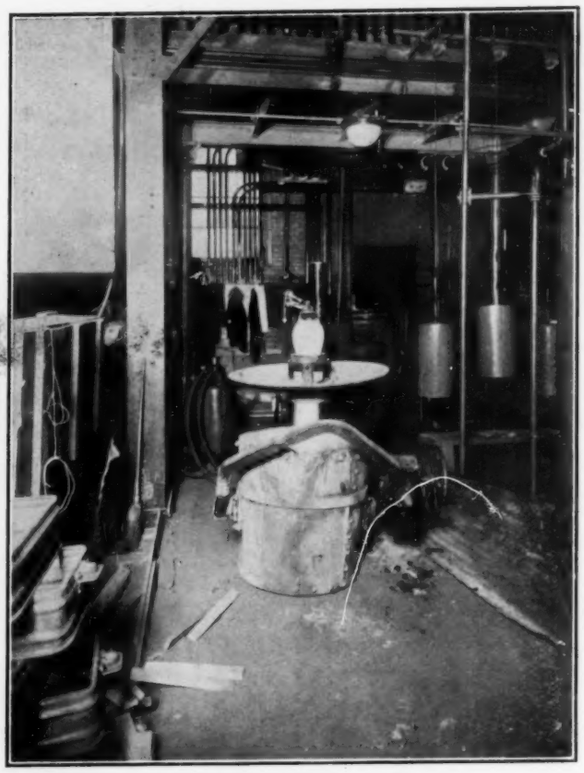
Views of the Electrified Foundry

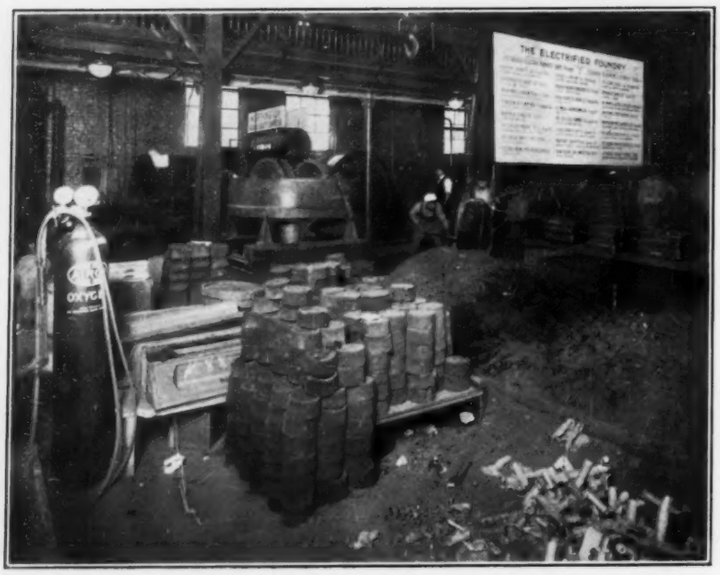




Views of the Electrified Foundry



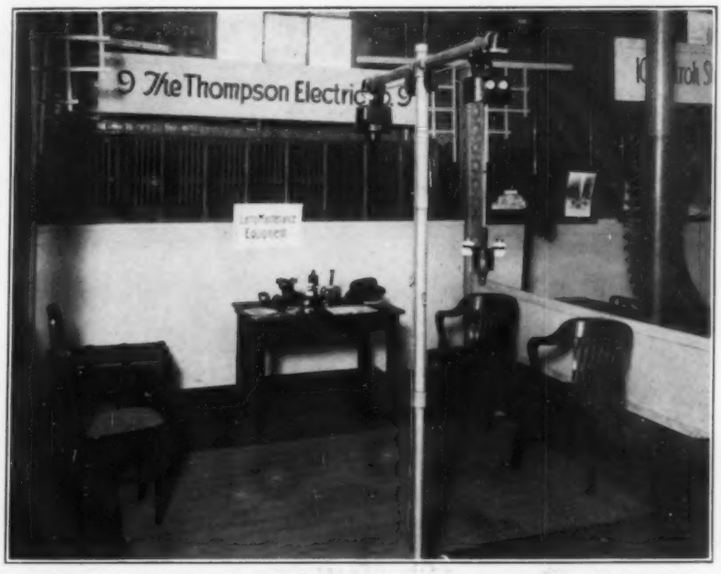




General views of the Electrified Foundry, the first completely electrified foundry ever constructed and successfully operated in America.

Booth No. 8

Motorbloc Corporation, Philadelphia, Pa.

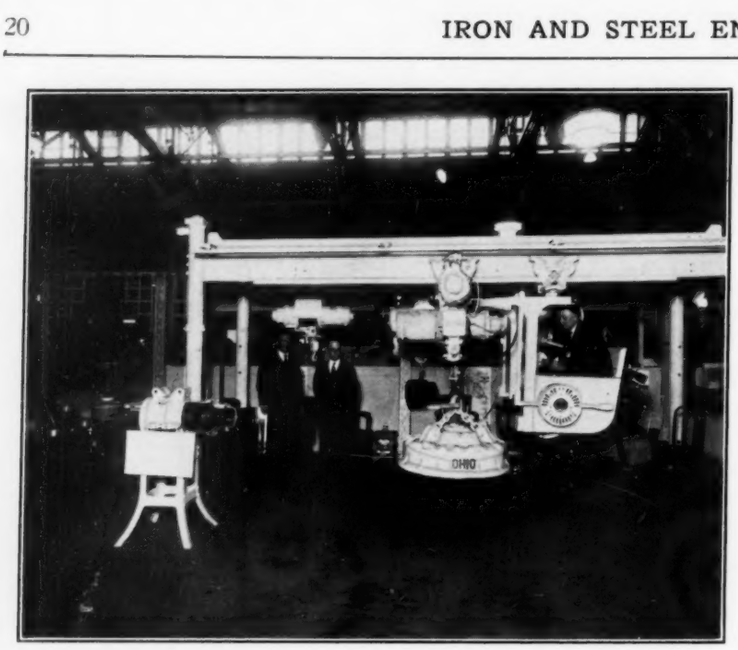


Booth No. 9

The Thompson Electric Company,
Cleveland, Ohio

Booth No. 10

Stroh Steel Hardening Process Company,
Pittsburgh, Pa.



Booth No. 11

Ohio Electric & Controller Company,
Cleveland, Ohio

Booth No. 69-70

Shepard Electric Crane & Hoist Company,
Montour Falls, N. Y.

Booth No. 13

The Hagan Corporation, Pittsburgh, Pa.

Booth No. 14-15

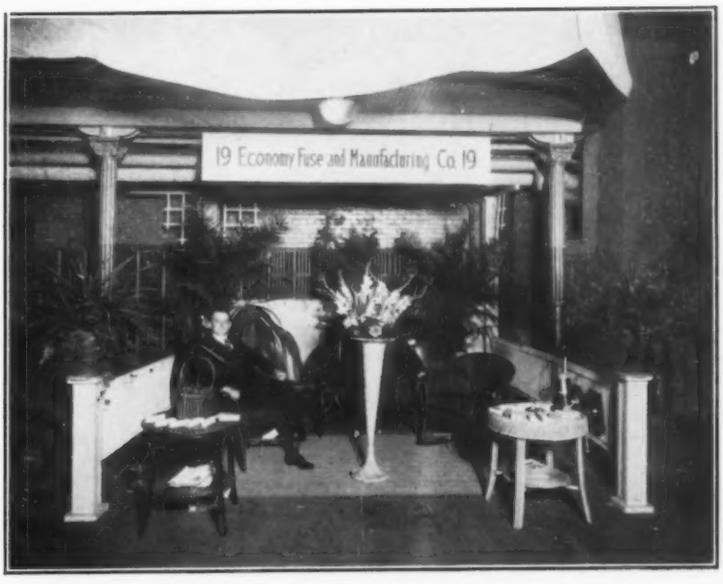
American Heat Economy Bureau,
Pittsburgh, Pa.

Booth No. 16

American Heat Economy Bureau,
Pittsburgh, Pa.

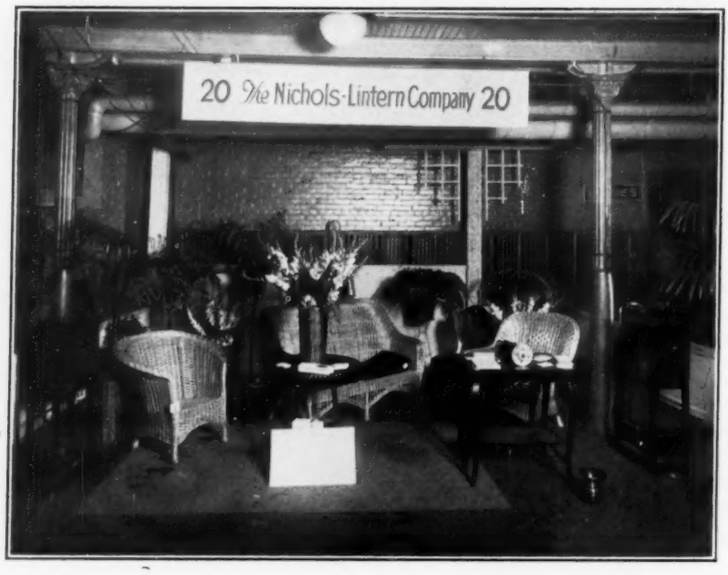
Booth No. 17

Bacharach Industrial Instrument Company,
Pittsburgh, Pa.



Booth No. 19

Economy Fuse & Manufacturing Company,
Chicago, Ill.



Booth No. 20

The Nichols Lintern Company,
Cleveland, Ohio

Booth No. 21

The Johns Pratt Company, Hartford, Conn.

Booth No. 22

Electric Service Supplies Company,
Philadelphia, Pa.

Booth No. 23
Johns-Manville, Inc., Chicago, Ill.

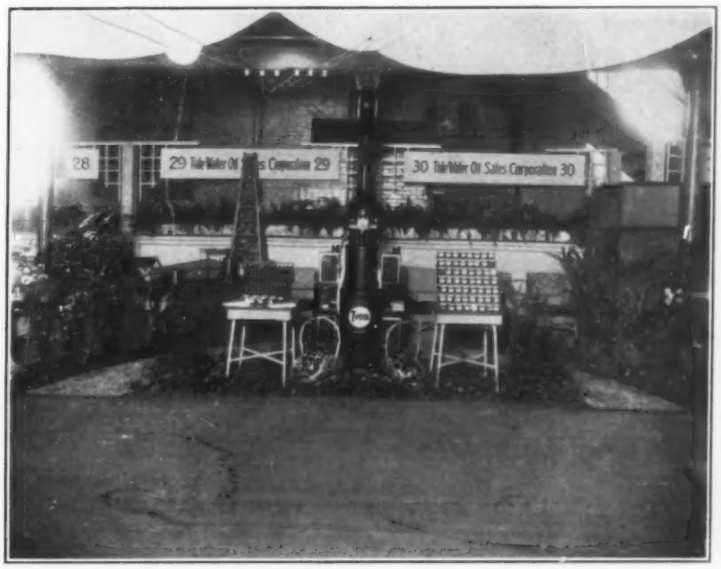
Booth No. 24
Northern Equipment Company, Erie, Pa.

Booth No. 25
Allan Manufacturing & Welding Company,
Buffalo, N. Y.

Booth No. 26
The Pyle National Company, Chicago, Ill.

Booth No. 27
Engineering Magazine Company,
New York, N. Y.

Booth No. 28
Rollway Bearing Company, Syracuse, N. Y.



Booth No. 29-30

Tide Water Oil Sales Corporation,
New York, N. Y.

Booth No. 31

Lockwood-Eslick & Pfohl, Buffalo, N. Y.

Booth No. 32

The Martindale Electric Company,
Cleveland, Ohio

Booth No. 33-34

Air Reduction Sales Company,
New York, N. Y.

Booth No. 35-36

The Gas Combustion Company,
Pittsburgh, Pa.

Booth No. 37

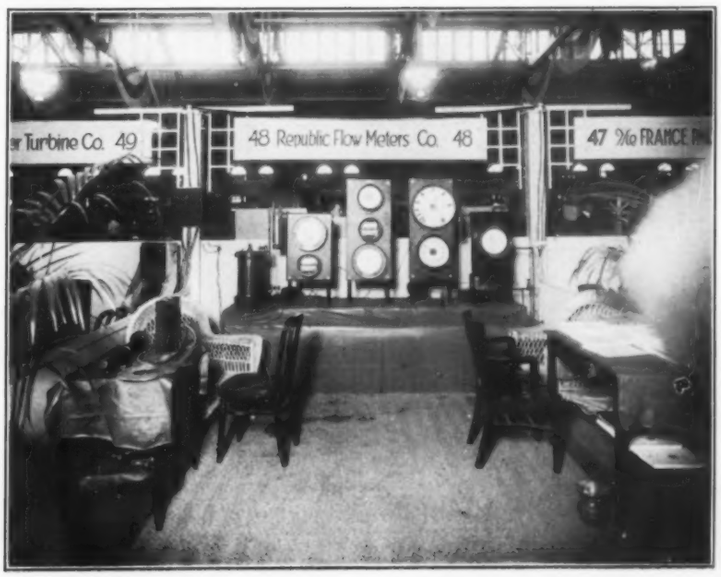
Sumet Corporation, Buffalo, N. Y.

Booth No. 38

Homestead Valve Manufacturing Company,
Homestead, Pa.

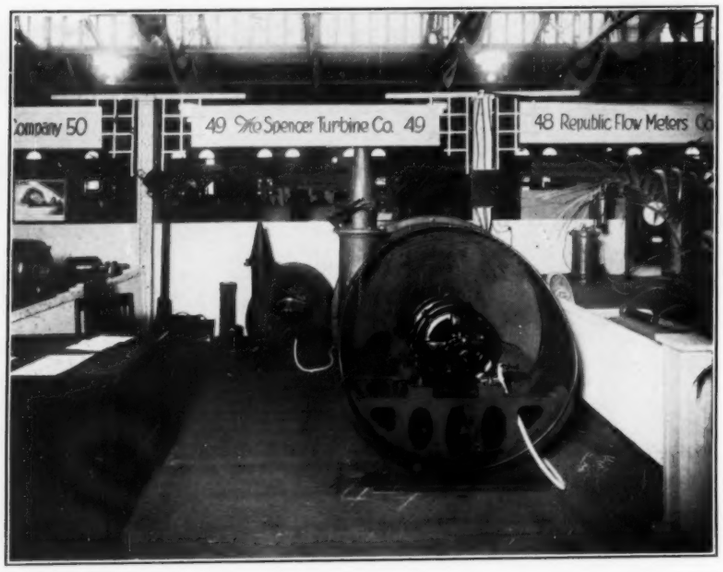
Booth No. 47

The France Packing Company,
Philadelphia, Pa.



Booth No. 48

Republic Flow Meters Company,
Chicago, Ill.



Booth No. 49

The Spencer Turbine Company,
Hartford, Conn.

Booth No. 50

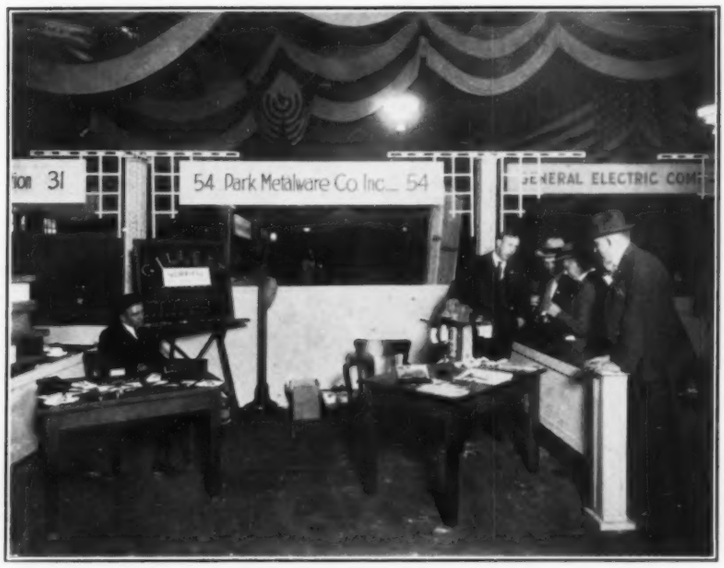
Crocker-Wheeler Company, Ampere, N. J.

Booth No. 51

Rockbestos Products Corporation,
New Haven, Conn.

Booth No. 53

The Superheater Company,
New York, N. Y.

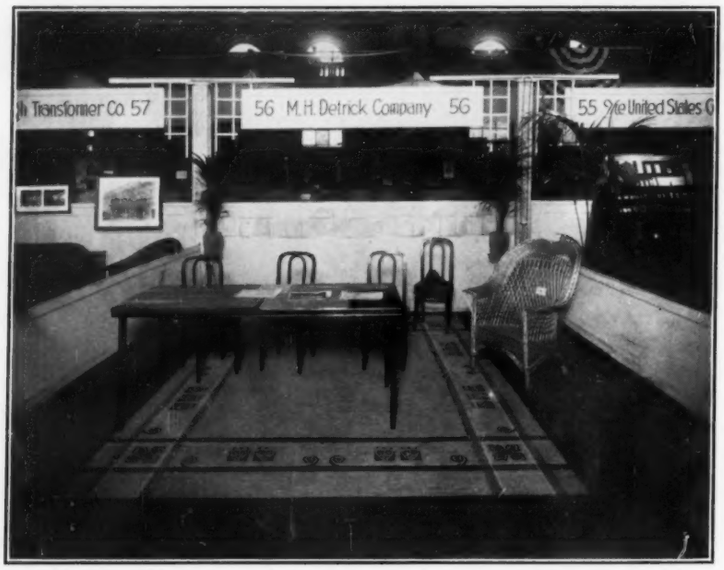


Booth No. 54

Park Metalware Company, Inc.,
Orchard Park, N. Y.

Booth No. 55

The United States Graphite Company,
Saginaw, Mich.



Booth No. 56

M. H. Detrick Company, Chicago, Ill.

Booth No. 58

Edison Storage Battery Company,
Orange, N. J.

Booth No. 67-68

The Pangborn Corporation,
Hagerstown, Md.

Booth No. 71-90

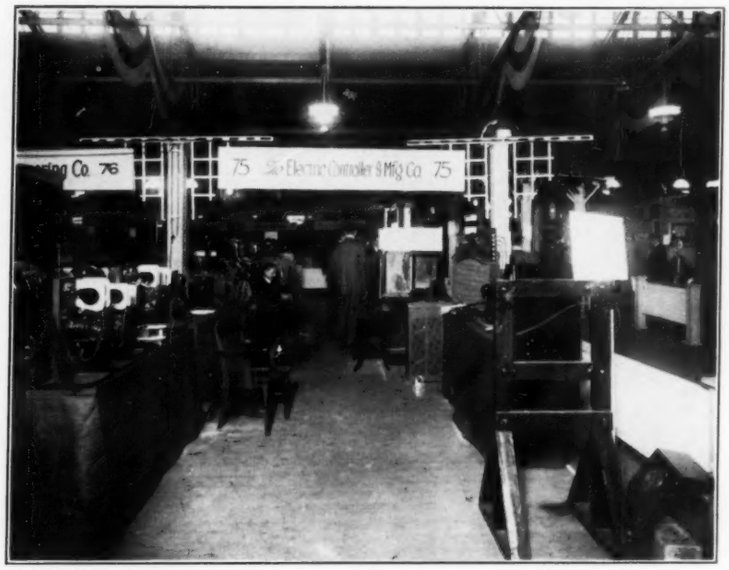
Western Electric Company,
New York, N. Y.

Booth No. 72

Thomas Flexible Coupling Company,
Warren, Pa.

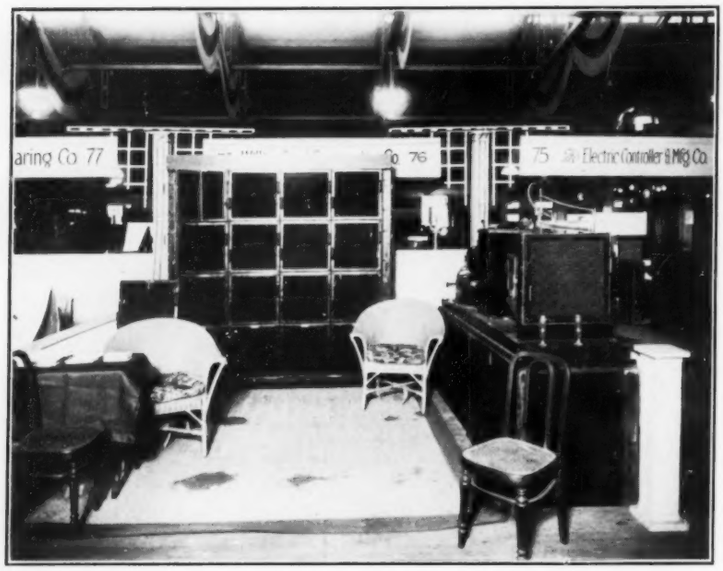
Booth No. 73

The Lumen Bearing Company,
Youngstown, Ohio



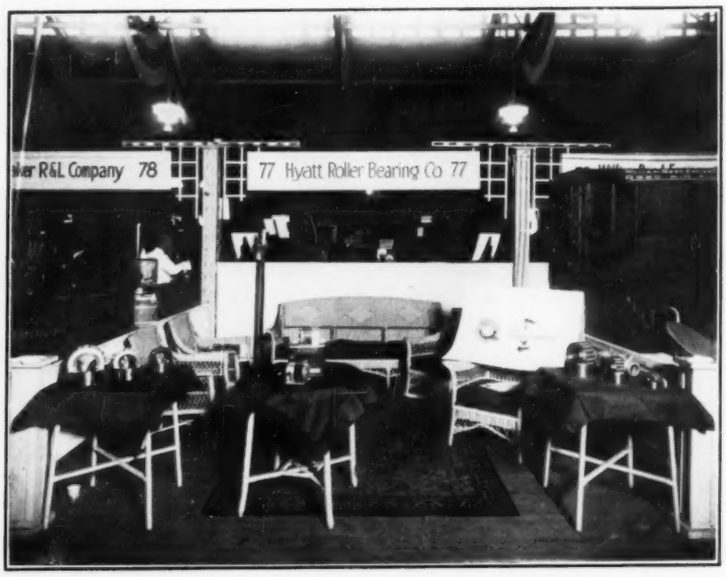
Booth No. 75-86

The Electric Controller & Manufacturing Company, Cleveland, Ohio



Booth No. 76

William Reed Engineering Company, Louisville, Ky.



Booth No. 77

Hyatt Roller Bearing Company, Newark, N. J.

Booth No. 78-83
Baker R & L Company, Cleveland, Ohio

Booth No. 79-80-81-82
V. V. Fittings Company, Philadelphia, Pa.

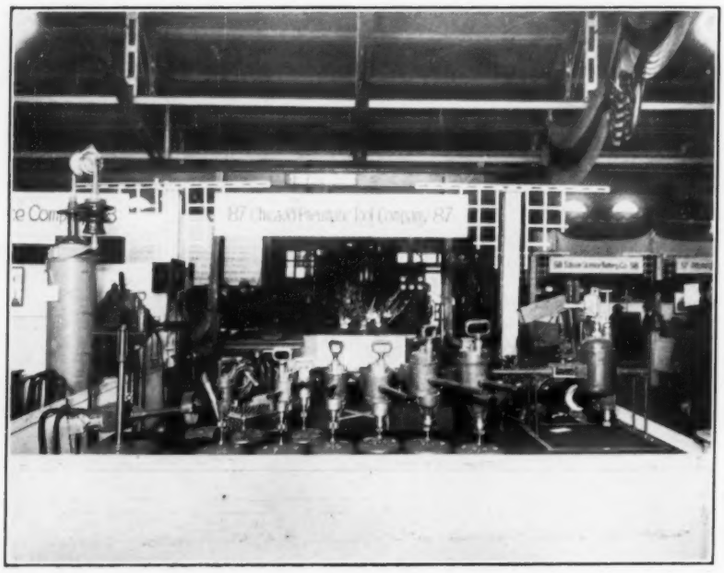
Booth No. 84
National Carbon Company
Long Island City, N. Y.

Booth No. 85

The Automatic Reclosing Circuit Breaker Company, Columbus, Ohio

Booth No. 75-86

The Electric Controller & Mfg. Company, Cleveland, Ohio



Booth No. 74-87

Chicago Pneumatic Tool Company, New York, N. Y.

Booth No. 88

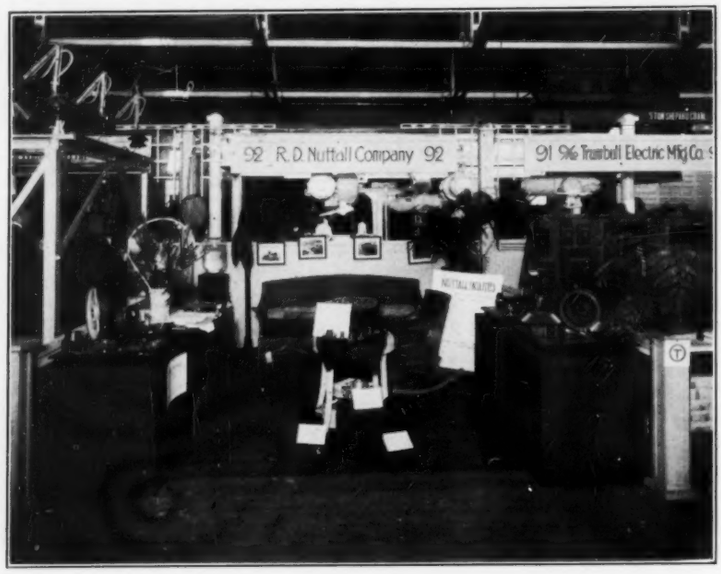
Electro Service Company, Marietta, Ga.

Booth No. 89

Allis Chalmers Mfg. Company,
Milwaukee, Wis.

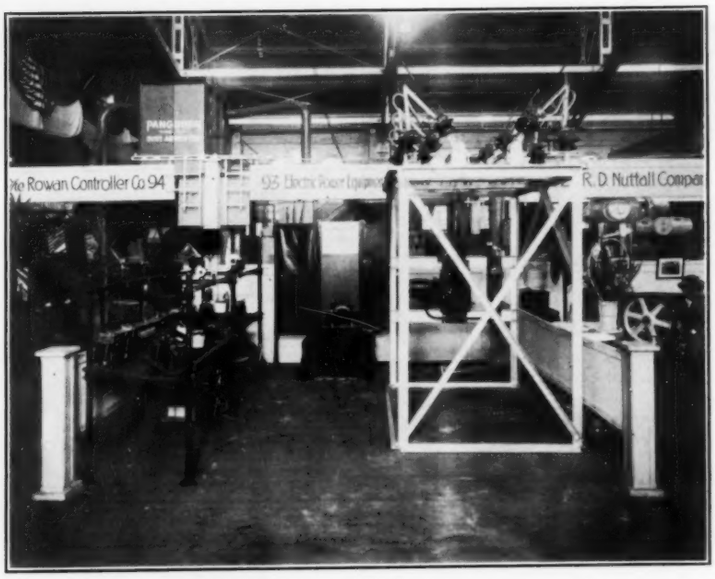
Booth No. 91

The Trumbull Electric Mfg. Company,
New York, N. Y.



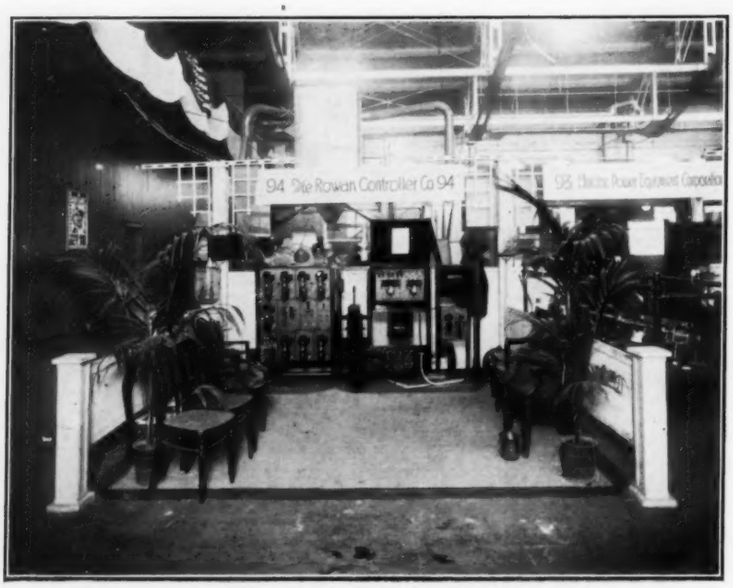
Booth No. 92

R. D. Nuttall Company, Pittsburgh, Pa.



Booth No. 93

Electric Power Equipment Company,
Philadelphia, Pa.



Booth No. 94

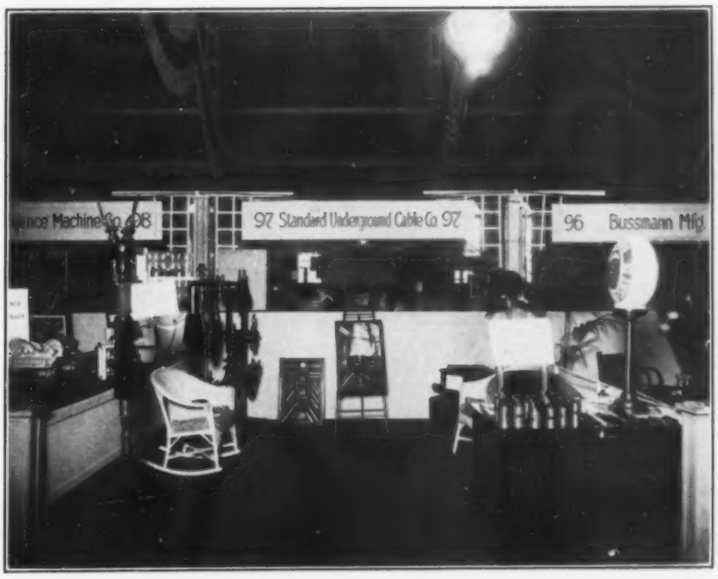
The Rowan Controller Company,
Baltimore, Md.

Booth No. 95-122

Keystone Lubricating Company,
Philadelphia, Pa.

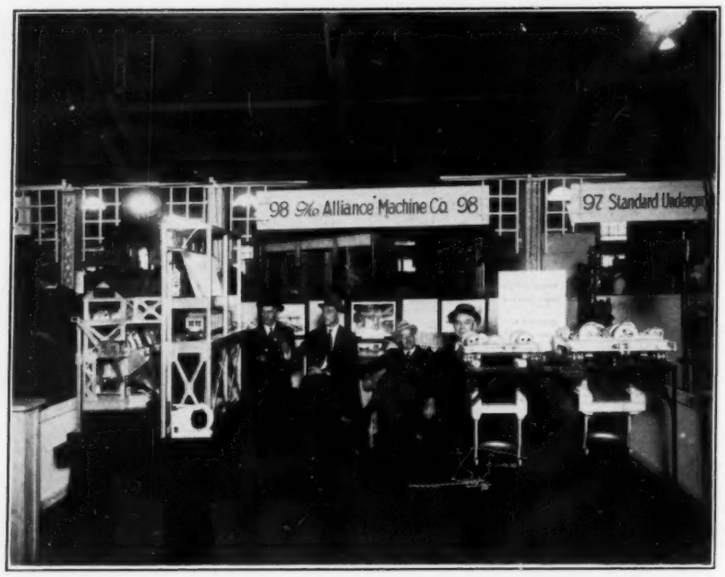
Booth No. 96

Bussmann Manufacturing Company,
St. Louis, Mo.



Booth No. 97

Standard Underground Cable Company,
Pittsburgh, Pa.



Booth No. 98

The Alliance Machine Company,
Alliance, Ohio

Booth No. 99

The Tool Steel Gear & Pinion Company,
Cincinnati, Ohio

Booth No. 100

The Packard Electric Company,
Warren, Ohio

Booth No. 101

Chicago Fuse Mfg. Company, Chicago, Ill.

Booth No. 102-115

Cutler Hammer Mfg. Company, Milwaukee, Wis.

Booth No. 105

Benjamin Electric Mfg. Company, Chicago, Ill.

Booth No. 106-111

The Hayward Company, New York, N. Y.

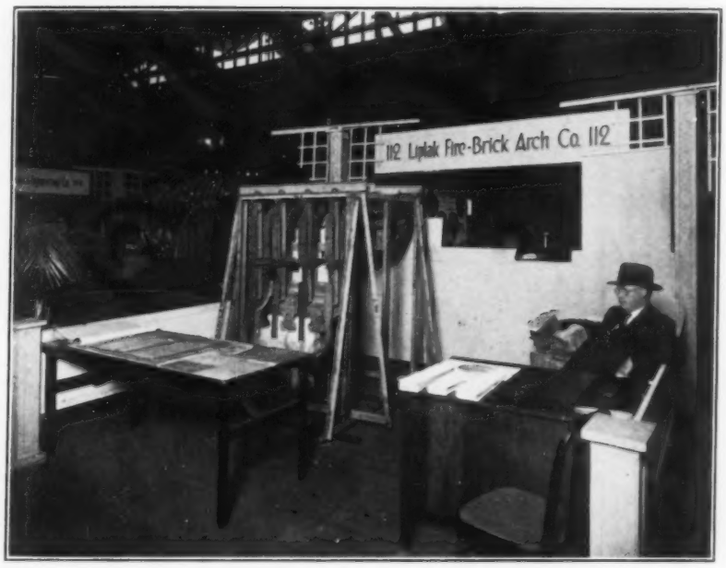
Booth No. 107-108

Cutter Electrical & Mfg. Company, Philadelphia, Pa.

Booth No. 109

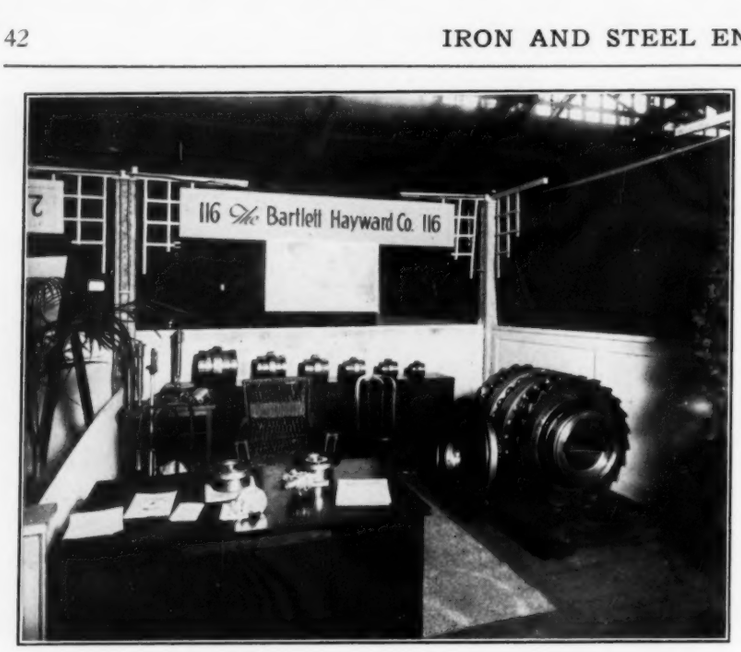
The Pittsburgh Electrical & Machine Works, Pittsburgh, Pa.

Booth No. 110
Appleton Electric Company, Chicago, Ill.



Booth No. 112
Liptak Fire-Brick Arch Company,
Chicago, Ill.

Booth No. 103-4-13-14
The Reliance Electric & Engr. Company,
Cleveland, Ohio

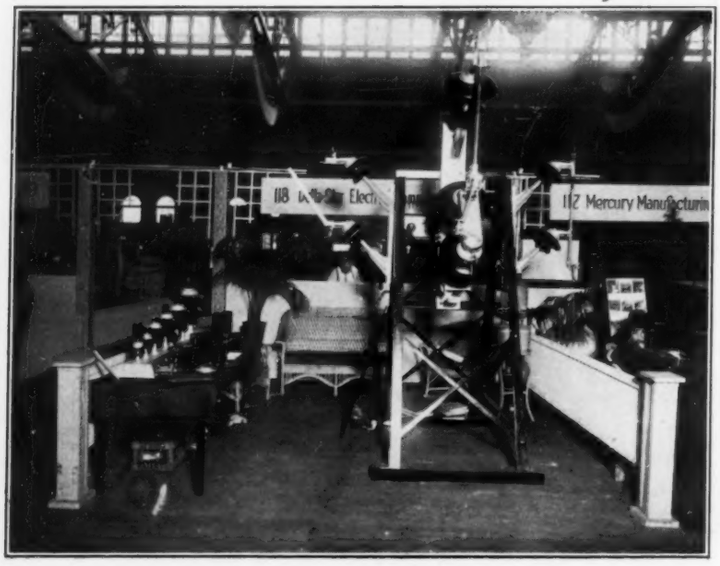


Booth No. 116

The Bartlett Hayward Company,
Baltimore, Md.

Booth No. 117

Mercury Manufacturing Company,
Chicago, Ill.



Booth No. 118

Delta Star Electric Company, Chicago, Ill.

Booth No. 119

Mutual Electric & Machine Company,
Detroit, Mich.

Booth No. 120

Chapman Valve Manufacturing Company,
Indian Orchard, Mass.

Booth No. 121

Boxill Bruel Carbon Brush Company,
Indianapolis, Ind.

Booth No. 123

The Electric Storage Battery Company,
Philadelphia, Pa.

Booth No. 124

Aero Pulverizer Company, New York, N. Y.

Booth No. 125

The Electric Journal Magazine,
Pittsburgh, Pa.

Booth No. 126

The Lakewood Engineering Company, Cleveland, Ohio

Booth No. 127-146

The Van Dorn Electric Tool Company, Cleveland, Ohio

Booth No. 128

Wright Hibbard Industrial Electric Truck Company, Phelps, N. Y.

Booth No. 129

The Electric Materials Company,
North East, Pa.

Booth No. 130-143

S K F Industries, Inc., New York, N. Y.

Booth No. 133

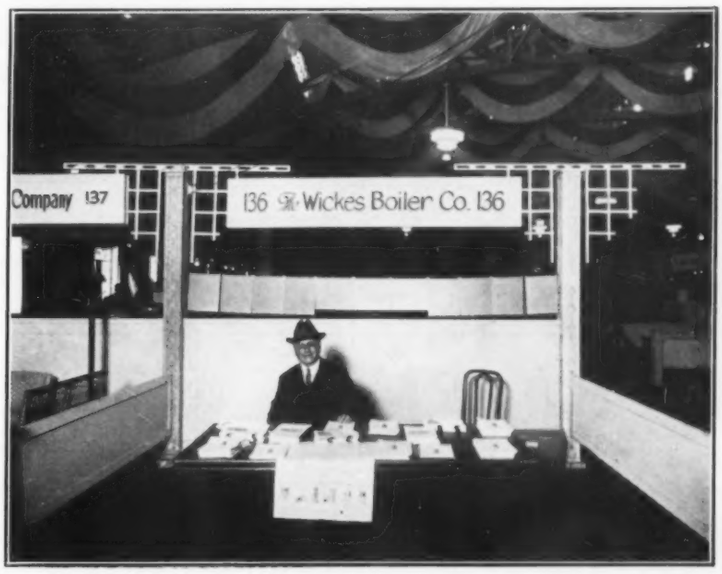
The Louis Allis Company, Milwaukee, Wis.

Booth No. 134

The Norma Company of America,
New York, N. Y.

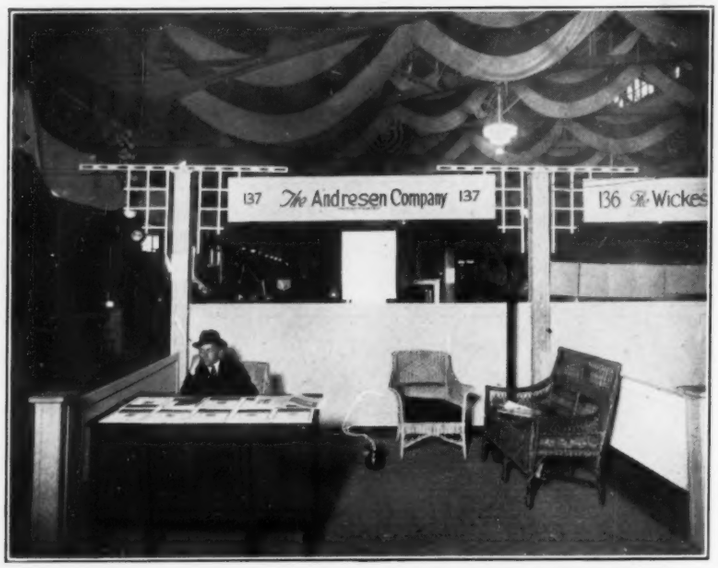
Booth No. 135

Corliss Carbon Company, Bradford, Pa.

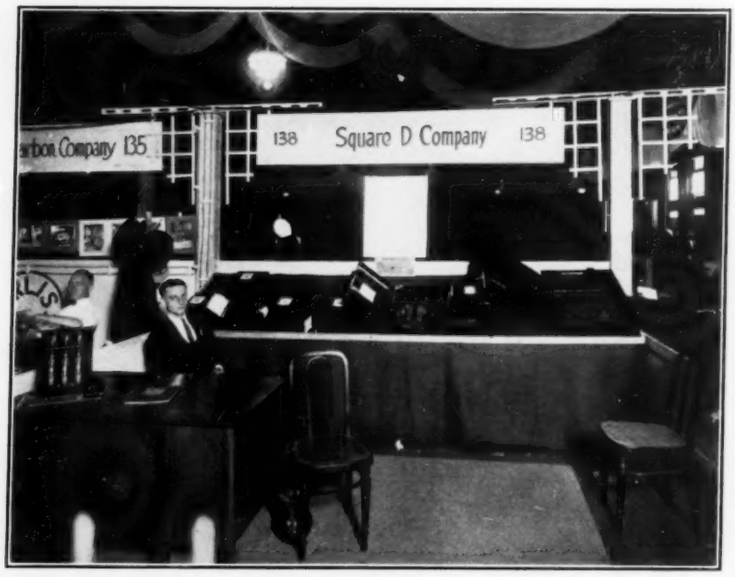


Booth No. 136

The Wickes Boiler Company,
Saginaw, Mich.



Booth No. 137
The Andresen Company, Pittsburgh, Pa.



Booth No. 138
Square D Company, Detroit, Mich.

Booth No. 139
Schweitzer & Conrad, Inc., Chicago, Ill.

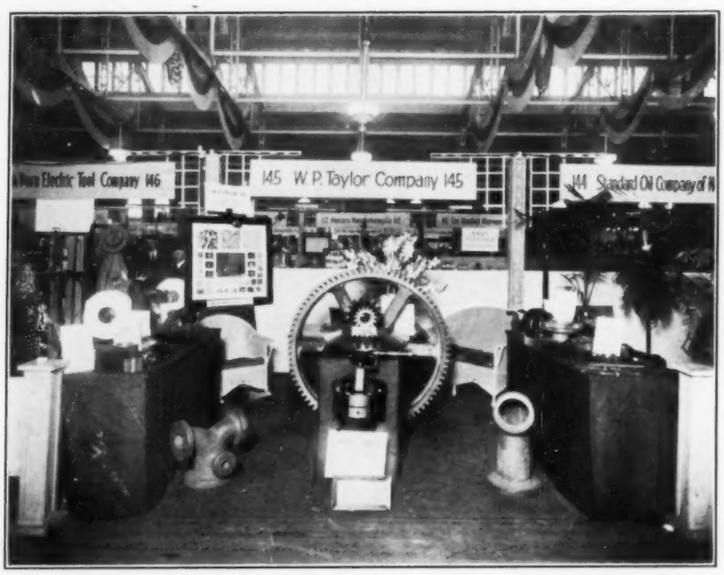
Booth No. 140
William G. Merowit, Buffalo, N. Y.

Booth No. 141
National Electric Mfg. Company,
Pittsburgh, Pa.

Booth No. 131-142
Crouse Hinds Company, Syracuse, N. Y.

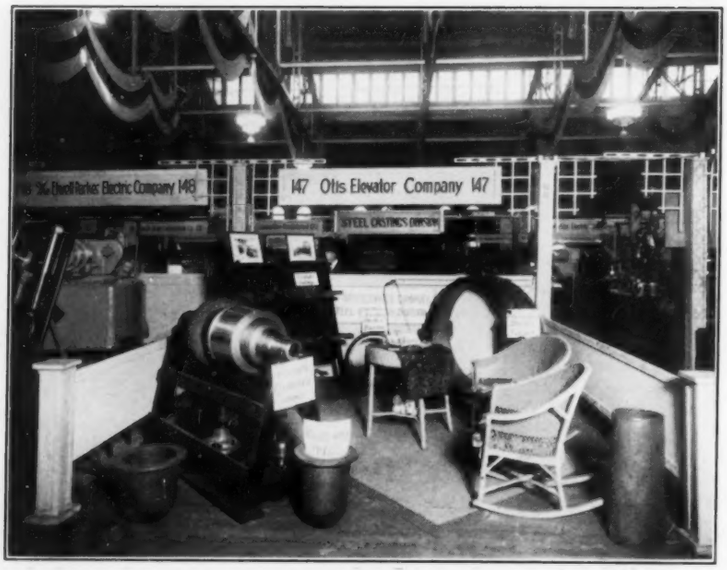
Booth No. 144

Standard Oil Company of New York,
Buffalo, N. Y.



Booth No. 145

W. P. Taylor Company, Buffalo, N. Y.



Booth No. 147

Otis Elevator Company, Yonkers, N. Y.

Booth No. 148-149

The Elwell Parker Electric Company,
Cleveland, Ohio

Booth No. 151-2-3-4-7-8-9-160

General Electric Company,
Schenectady, N. Y.

155 Mutual Foundry & Machine Co. 155
PRACTICAL DEMONSTRATION
BROWNING ARMATURE COIL SPREADER
BROWNING LOOP and FIELD WINDER

Booth No. 155

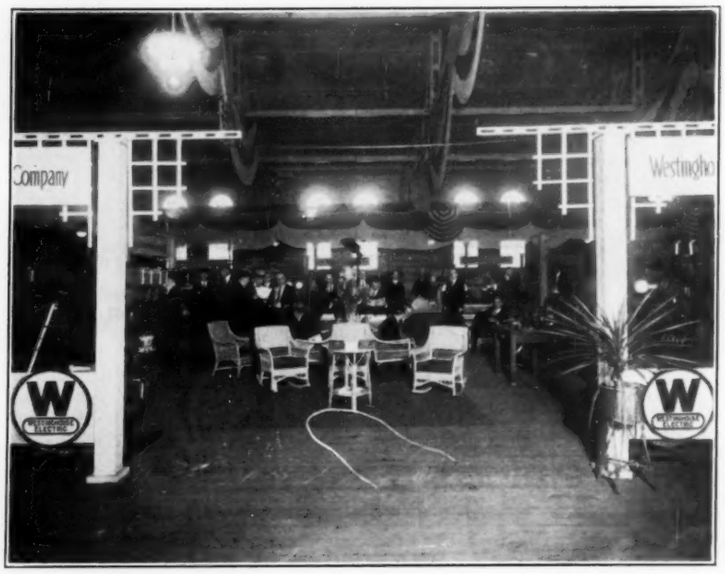
Mutual Foundry & Machine Company,
Atlanta, Ga.

Booth No. 156

Farrell Foundry & Machine Company,
Buffalo, N. Y.

Booth No. 163-4-5-6-7-8

Westinghouse Electric & Mfg. Company,
East Pittsburgh, Pa.



This is a photograph of one of the trucks which the Baker R & L Company so kindly loaned our Association in order that we might accomplish the task of erecting, dismantling and hauling the material used in the various exhibits. For this the Society is very grateful.

The Next
IRON & STEEL EXPOSITION

will be held in the

City of Pittsburgh, Pa.

during the month of

SEPTEMBER 1924

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WORLD POWER CONFERENCE

Barton R. Shover, Consulting Engineer of Pittsburgh, Pa., and Past President of the A. I. & S. E. E. has been appointed to present a paper before the World Power Conference to be held at the British Empire Exhibition at Wembley, London.

Mr. Shover's subject will be "Power in the Steel Industry."

The conference is being promoted by the council of the British and Allied Manufacturers Associations in co-operation with technical and scientific institutions and industrial organizations in Great Britain and other countries.

Mr. Shover's connection with the steel industry dates back to the year 1895 when he became foreman of the electrical department of the Ohio Steel Com-

B. R. SHOVER

pany, and in 1898 became chief electrician. In 1906 he accepted a position with the Indiana Steel Company at Gary, Ind., as their electrical engineer and continued in this capacity until 1910 when he became superintendent of the Brier Hill Steel Company at Youngstown, Ohio. In 1912 he accepted a position as general manager of the Tata Iron and Steel Company in India which position he held for three years. In 1915 he opened offices in the City of Pittsburgh, Pa., as consulting engineer.

Mr. Shover has been responsible for the Shover Interlocking Blast Furnace Charging Mechanism, designed and constructed the electrical installation at the Gary Works of the Indiana Steel Company; the electrical installations of steel works and rolling mills of the Brier Hill Steel Company; large plant additions and operating improvements for the Tata Iron & Steel Company.

Fuel Saving Conference

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Achievements in the Steel Industry During the Year 1923

By G. E. STOLTZ*

PROBABLY the most significant feature of this year's work is the large number of motors that are being installed to replace steam engines. This not only permits the replacement of engines whose economy varies with the physical condition of the engine, but also eliminates individual boiler plants and long steam lines, thereby concentrating the generation of power in single and economical stations.

If we are to realize the full economy in the utilization of steam, whether it be in turbines or engines, a high grade supervising engineering force is necessary. Where large blocks of power are generated in a single station this can be obtained at a comparatively low cost. Small steel plants having but a few steam engines in service can hardly afford to maintain an organization equipped to insure the best economy. Quite a number of instances come to our attention where small steel plants have one or two steam engines supplied from a small boiler plant, the overall economy being much below that which might reasonably be expected. On closer analysis it is found that on such small installations high grade supervision does not seem to be practical. This condition, of course, does not prevail where motors are used, as the economy of electric motors and transmission lines does not vary with operating conditions or service.

In the past, steel mill engineers have given this subject of electrification considerable thought. All are interested in reducing the cost of operation in a plant and the experience gained over a period of the last 15 years, has established the fact that electric drive has many broad advantages that warrant its adoption as a standard system of mill drive. This conviction has been shown by the large number of motors now being purchased to replace steam engines. This, of course, more definitely indicates the appreciation of advantages to be gained by electric drive than the electrification of new mills.

Fig. 1 gives the results of a test made on a 36-in. reversing mill driven by a twin non-condensing en-

*Electrical Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

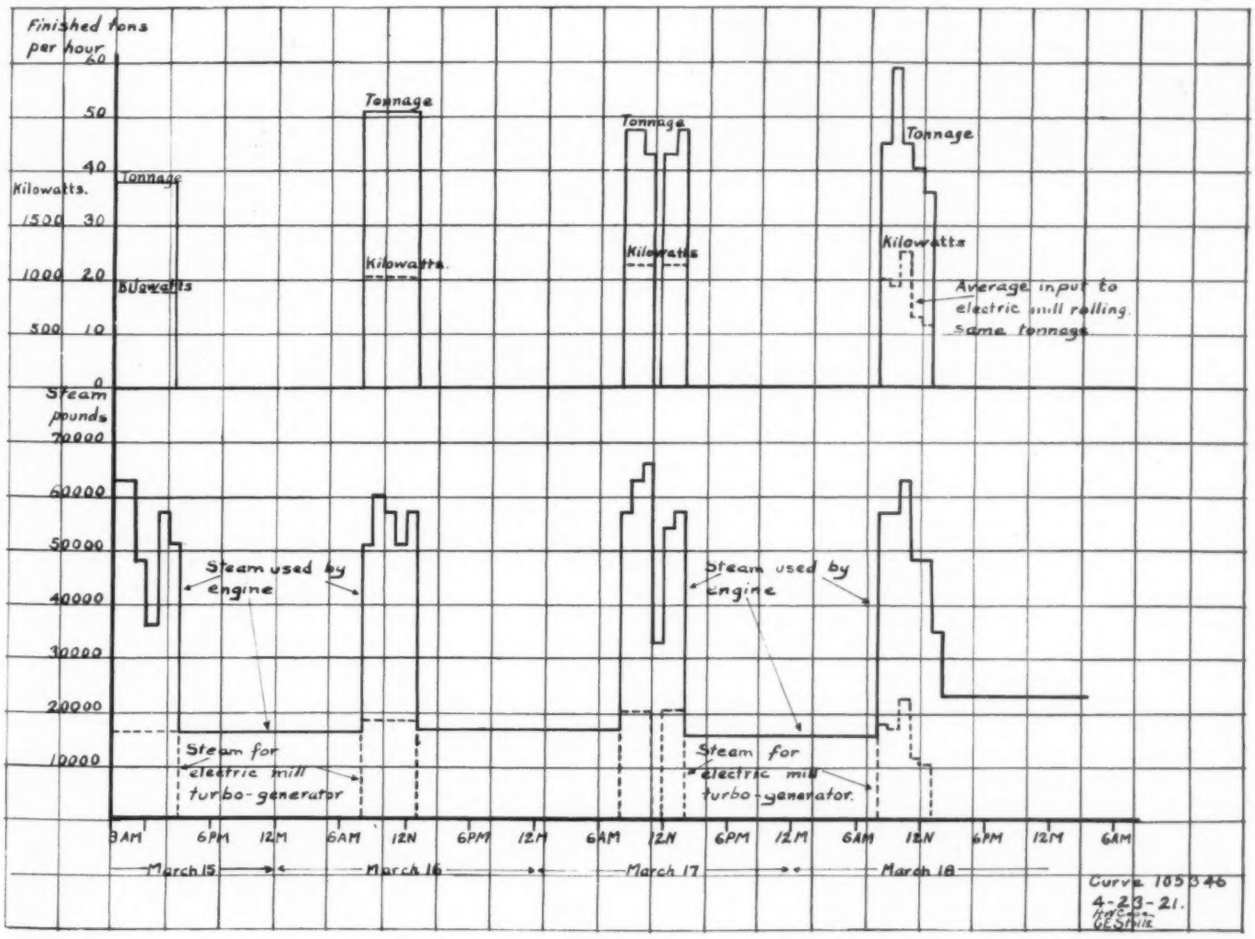

FIG. 1.

gine when rolling four hours each day. This was during March, 1921, when business was very slack. Nine boilers were segregated and the feed water carefully weighed, so that there is no question in regard to the amount of steam used by the engine, as well as resulting condensation and leaks. These boilers were connected only to this engine for a period of four days. The tonnage output per hour averaged about 45 tons. During the period when steel was being rolled the amount of steam required per hour was approximately 55,000 lbs. The most significant part of this test was brought out by the fact that approximately 16,000 lbs. of water were required per hour to take care of condensation, leaks, etc.

Tests made on electric driven mills would indicate that if this mill were electrically driven an average of 1000 k.w. would be required during the period the mill was operating. Making a very liberal allowance for water rate on a 5000 k.w. turbine, two of which are installed in this plant generating power for other uses, it was found that this work could be accomplished electrically on approximately 17,000 lbs. of water per

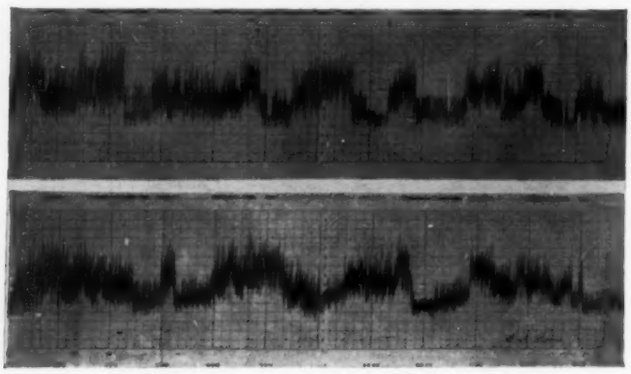

FIG. 2.

hour. This is practically the same amount as was taken by the boilers during the period when the mill was not in operation.

Fig. 2 is a graphic chart indicating the total k.w. generated in a large electrically driven mill over a period of 24 hours. This chart was obtained in March, 1921, during the same period of depression. It can be noted that there are periods when it is evident that one of the large mills is off, but as a whole the boiler plant and generating equipment are operating at a fairly constant load throughout the entire day. It is under this condition that the greatest economy can be obtained.

Two Westinghouse 5,000 h.p. wound rotor induction motors with liquid regulator control have just been installed at the South Chicago plant of the Illinois Steel Company. These motors are connected to the mill through herringbone gear units with overhung flywheels on the pinion shaft. One of the motors is used to drive a 90-in., three-high plate mill and the other a 132-in., three-high plate mill. The power requirements on the two mills differ, but the motors were duplicated in order to reduce the cost of spare parts which would have to be carried. Both of these motors were used to replace steam engines, the change being made to improve the fuel economy of the plant.

Another plant which is installing two motor equipments is the Phoenix Iron Company where they are planning on replacing engines with motor drive to operate on purchased power. They have a 24-in., three-stand, three high structural mill which is now driven by a twin reversing type engine. This is to be replaced by a 3000 h.p. adjustable speed motor, which will receive its power from a 2500 k.w. generator, 600 volts. This motor will be operated from a pulpit in the same manner as a reversing type motor. In normal operation the motor will not be reversed but will have its speed rapidly adjusted, in order to meet the requirements of various passes made in the mill. The roughing passes will be made at comparatively slow speed and the finishing passes at the high speed. The flywheel set will have a 60,000 lb. flywheel and the wound rotor induction motor driving this flywheel set has a capacity of 2500 h.p. The induction motor will be provided with a liquid slip regulator for equalizing the intermittent loads obtained from the mill.

The Phoenix Iron Company also has an engine driven 22 in. bar mill which is now being equipped with a 2500 h.p. wound rotor induction motor controlled by a slip regulator. This motor is connected to the mill from a herringbone gear unit and has a flywheel to equalize the load. This wound rotor induction motor is designed to be used later with an auxiliary equipment which will make it possible to operate the equipment as an a.c. adjustable speed set. All of this equipment for the Phoenix Iron Company is being supplied by Westinghouse Electric & Manufacturing Company.

Two large installations are being made at the Lackawanna plant of the Bethlehem Steel Company, where reversing engines will be replaced, one on a 40-in. reversing blooming mill and the other on a 48-in. universal plate mill.

The 40-in. reversing bloomig mill will be equipped with a 7000 h.p. double unit reversing motor having a speed range of 0 to 120 r.p.m. This motor will be supplied with power from a flywheel set having two 3000 k.w. generators, a 100,000-lb. flywheel and a 3750 h.p. wound rotor induction motor.

The 48-in. universal plate mill engine is being replaced by a 5000 h.p. reversing motor which will be supplied with power from a flywheel set having a generating capacity of 4200 k.w., a flywheel of 100,000 lbs. and a wound rotor induction motor of 4000 h.p. capacity. The motor for this mill is a single unit motor and the generating capacity consists of two 2100 k.w. generators, which will operate in parallel. This will be the first installation on a reversing mill where a single unit motor is supplied with power from two generators. Both of the equipments for the Lackawanna plant are being built by the Westinghouse Electric & Manufacturing Company.

The Westinghouse Company is also supplying a 1500-h.p., 230-volt, d.c. adjustable speed motor to drive the finishing train of a rod mill which is operated by an engine. This motor will receive its power from a 1000 k.w. synchronous motor generator set. Purchased power is being used for this equipment.

The reels on this rod mill are also to be driven by a direct current adjustable speed motor. The speed range of this motor is sufficiently wide to make it possible to reel metal from any one of three different trains all operating at different speeds. The present engine will be used to drive the roughing and intermediate trains of the mill and it will be necessary to control the speed of the 1500 h.p., d.c. motor on the finishing train, as well as the 75 h.p. motor used to

drive the reels, so that they will operate in synchronism with the roughing and intermediate trains driven by an engine. The control which accomplishes this is so arranged that adjustments can be made when the mill is first started to bring the two d.c. motors to the speed desired. After this adjustment has been made no further attention is required, as the control will cause the d.c. motors to change their speed in accordance with any changes in speed by the engine.

This same type of control has been in successful operation at the plant of the Minnesota Steel Company where metal is delivered from various stands depending upon the product being rolled. The reel motor is adjusted in speed to cause the reels to operate at a speed corresponding to the delivery speed of the particular stand from which metal is being delivered. After this is done the control will cause the reel motor to change in speed in accordance with any change made by the a.c. induction motor driving the mill.

One of the most distinctive installations made during this last year has been the equipment supplied for a 16-in. hot strip mill at the plant of the West Leechburg Steel Company. The electrical apparatus was furnished by the Westinghouse Electric & Manufacturing Company. The roughing stands of this mill are driven by a 1500-h.p., 705-r.p.m. wound rotor induction motor. A herringbone gear unit is used between the motor shaft and the continuous lay shaft which drives the individual stands through bevel gearing. The slabs are taken out of the furnace and carried through this straight line of roughing stands. It is then transferred and brought back in the reverse direction through the intermediate and finishing stands. The first two intermediate stands are driven by a 1500-h.p., 705-r.p.m. motor duplicate of that used on the

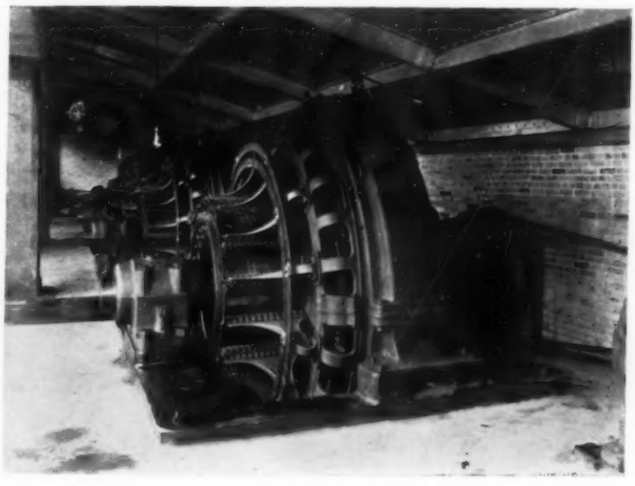

FIG. 3.

roughing train. A herringbone gear unit is used to connect the motor to the continuous lay shaft which is connected to intermediate stands through bevel gearing.

The last four stands are used for finishing and are located close to each other in tandem, each stand being driven by a d.c. adjustable speed motor, with compensating winding to give flat speed regulation throughout the entire range. A view of these motors is shown in Fig. 3. The last two stands are driven by 1800 h.p. motors and the two other finishing stands are driven by 1500 h.p. motors. Power for this mill is purchased and that supplied to the four d.c. motors on the finishing stands is obtained through two, three unit motor generator sets. Each of these two motor generator sets consists of two 1000 k.w. generators, making a total direct current generating capacity of 4000 k.w. The entire equipment is controlled from one pulpit by one operator. The fact that the finishing

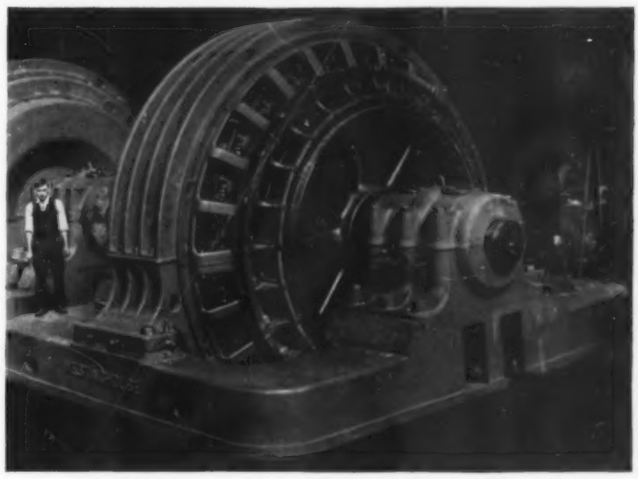

FIG. 4.

end of this mill consists of tandem stands located near each other permits the finishing of this steel in a very short period of time and avoids rapid cooling. This makes it possible to finish thin sections.

The Westinghouse Electric & Manufacturing Company is now building electrical apparatus to equip completely a plant being erected in Spain by the Cie Siderurgica del Mediterraneo. The mills consist of a 40-in., two-high reversing blooming mill which is to be driven by a 5000-h.p., 700-volt d.c. motor having a speed range of 0 to 120 r.p.m. This motor is being built as a single unit and represents the largest single unit reversing motor built in this country. A view of this motor is shown in Fig. 4. Following this mill is a three-stand, three-high, 28-in. structural mill which is to be driven by a 3750-h.p., 700-volt reversing type motor having a speed range of 60 to 150 r.p.m. Normally this motor will be operated in one direction only but will be used to make rapid changes in speed as may be required by the material in the mill. Both of these motors are supplied with direct current power from a common flywheel motor generator set, one generator being used for the motor on the blooming mill and the second generator for the motor on the structural mill. Each of these motors will be controlled from an individual pulpit at the mill. The flywheel set has a 180,000 lb. flywheel which will equalize the load from both mills. The set is driven by a 5000 h.p. wound rotor induction motor.

In this same plant will be a 110-in. plate mill which will be driven by a 3000 h.p. wound rotor induction motor connected to the mill through a herringbone gear unit. The flywheel effect is being included on the pinion shaft. Auxiliary motors and control are included and will be supplied with direct current power through rotary converters and transformers.

The shortage and high price of labor has developed a tendency to utilize automatic equipment wherever possible. Five automatic substation equipments have

been sold to the Carnegie Steel Company, Edgar Thomson plant, to control 1000 k.w. motor generator sets. Another equipment has been sold to the McKinny Steel to control the same size set, and two to the Lackawanna plant of the Bethlehem Steel Company to operate two 1000 k.w. motor generator sets.

It has been felt by many engineers in the steel mill industry that automatic sub-station equipments would not necessarily be justified, due to the fact that the equipmen is not spread over a large territory, but the importance of reducing labor costs has over-ruled this opinion.

Some Electrical Developments

By J. D. WRIGHT*

IN a number of respects the year 1923 has been a record one for main roll drives. The total horsepower of motors purchased will not greatly exceed 1922, but several new equipments deserve special mention.

The application of synchronous motors to main roll drives has always been recognized as desirable because of their beneficial effect on the plant power factor. However, their use has heretofore been extremely limited on account of the fact that the starting requirements on all mills occasionally demand a torque considerably in excess of normal. High starting torque is a characteristic in which the normal synchronous motor is deficient. This deficiency has been overcome in a synchronous motor of special mechanical construction consisting of the suspension of the armature (stator) so that it can rotate during the starting period. Hollow journal extensions on the end shields are carried by bearings at the inner ends of the pedestals which carry the motor shaft. The periphery of the frame is machined for a braking surface and is fitted with a band brake similar to those used on mine hoists. The current is taken to the armature winding through rings which are normally stationary. When starting with load, the brake is released so that the frame is free to rotate when power is applied by means of the usual starting compensator. When the armature is rotating at nearly maximum speed, the field (rotor) is excited and the armature comes to synchronous speed. The starting and speeding up of the field and connected load may then be effected by applying the brake to the rotating armature. The acceleration proceeds to synchronism proportionally as the armature is brought to rest. The brake is then locked and the machine becomes a normal synchronous motor.

During the entire period of acceleration of the field from zero to synchronous speed, the motor is capable of applying to its connected load a torque equal to its maximum pull-out torque and several times greater than the starting torque of the usual type of synchronous motor. The current required for starting the connected load is proportional to the per cent of normal torque required. That is, if the load requires a starting torque of twice normal full load torque, the current drawn from the line will be twice normal full load current.

These revolving frame synchronous motors have had extensive application in the cement industry and two motors are now being built to drive copper rolling mills at the plant of the Rome Brass & Copper Company. Each motor is rated 580 kva., 70 per cent power factor (500 hp.), 360 rpm., 440 volts, 60 cycles, and will be connected to the mill through a herringbone gear unit without flywheels. It will be noted that these motors have considerable kva. capacity available for power factor correction. With normal field excitation each machine will deliver 415 leading kva. at 500-hp. load and 490 leading kva. at 100-hp. load.

One of the most important developments of the year is the building of two polyphase brush shifting a.c. adjustable speed motors with shunt characteristics for rolling mill drive. This motor, known as the Type BTA, has primary and secondary windings similar to those of a standard slip ring induction motor, except that the primary winding is placed on the rotor and the supply lines are connected to the slip rings. In the same rotor slots there is provided a second winding known as a regulating winding, which is constructed like a d.c. armature winding and connected to a commutator. The stator is provided with a phase wound secondary winding and each phase is brought out separately, one end of the phase to one brush yoke and the other end of the phase to another brush yoke. These brush yokes are mounted one at each end of the commutator and are shifted by suitable mechanism so constructed as to move the brush yokes in opposite directions.

The secondary winding is so connected that the circuit through each phase is completed by means of the commutator. When the brushes of both yokes are in line on the same commutator bars, the secondary phases are short circuited and the motor operates as an induction motor. Inasmuch as the regulating winding is placed in the same slots as the primary winding, an alternating voltage of constant flux is induced in the regulating winding by the primary flux. As the brushes are moved apart a section of the regulating winding is included in series with the secondary winding, thereby injecting into the secondary circuit a voltage which, by proper design, has the effect of changing the speed of the motor. This voltage may be made to assist or oppose the voltage of the secondary winding, thereby causing the motor to operate either above or below synchronous speed. This motor has characteristics practically identical with the double range Scherbius equipment and fills a long-felt want for an adjustable speed a.c. drive where the power required is too small to make Scher-

*Electrical Engineer, General Electric Company, Schenectady, N. Y.

bius or Kraemer apparatus feasible on account of the high initial cost of small installations.

These two Type BTA motors were purchased by the Halcomb Steel Company of Syracuse, N.Y., one for driving a 9-in. merchant mill rated 14 poles, 600-400-200 hp., 321-214-107 rpm., 440 volts. The second motor drives a 14-in. merchant mill and is rated 30 poles 500-385-250 hp., 130-100-65 rpm., 440 volts.

During the year three machines were constructed, each being the largest of its type ever built in America, so far as can be learned from published lists. The first was a 4500-4500 horsepower, 500-300 rpm., 25 cycles, 2,200 volts Kraemer equipment to drive a 14-in. merchant mill at the plant of the Inland Steel Company. The two other motors, built for the Ford Motor Company, were an 8,000-hp., 240-rpm., 13,200-volt, 60-cycle constant speed induction motor for driving an interrupted continuous blooming mill and a 4500-4500 hp., 110-67½ rpm., 500 volt, d.c. motor for driving a 14-in. merchant mill. The 8,000-hp. motor has the highest continuous horsepower rating of any motor built in America. It is also the first induction motor for steel mill service to be wound for an operating voltage in excess of 6,600 volts. The 4,500-hp. motor has the highest continuous horsepower rating of any single unit d.c. motor built in this country.

The fact that the substitution of electric main roll drives for existing steam driven units will show an excellent return on the investment is being continually demonstrated by additional installations. During the year the Jones & Laughlin Steel Corporation replaced engine drives by the installation at their Woodlawn plant of two 5,750-hp., 94-rpm., 6,600-volt, 25-cycle induction motors for driving 18-in. and 21-in. billet mills.

The Consolidated Rolling Mills Company of Mexico City has purchased two induction motors for replacing steam engines, a 300-hp. to drive a 16-in. roughing mill, and a 500-hp. to drive a 10-in. merchant mill.

The recent electrification of the 30-in. reversing universal skelp mill at the Youngstown plant of the Youngstown Sheet & Tube Co. also marks an important step forward in the electrification of steam driven mills. This is the third large mill at this plant which has had the engine drive replaced by an electric motor. This motor drive, which replaced a twin simple reversing steam engine, is rated 4,000 hp. at 80-135 rpm., and is capable of exerting a maximum torque of 592,000 pounds at one foot radius at any speed from zero to 80 rpm. The motor is a double unit machine, having two armatures mounted on a common shaft. The armatures were made small in diameter so as to obtain low stored energy. This feature of design reduces the power required for acceleration and also permits more rapid acceleration than would be possible with a motor having large stored energy. During the process of rolling the slab into skelp no manipulation of the metal is required, it being necessary only to operate the screw-down to adjust the draft and to make adjustments in the setting of the vertical rolls. The reversing of the main driving motor must, therefore, be extremely rapid to prevent delays in rolling steel.

Power for the double unit reversing motor is obtained from a flywheel motor generator consisting of a slip ring induction motor rated 2,500 hp., 500 rpm., 6,600 volts, 3 phase, 25 cycles. This motor drives two 1,800-kw., 650-volt d.c. generators and a 78,000-lb. steel plate flywheel which has a stored energy of 132,000 horsepower seconds at a speed of 500 rpm. Both the motor and motor-generator are forced ventilated, each by an air conditioning equipment supplying 30,000 cu. ft. of air per minute.

Two-speed induction motors are still occasionally used for mill drives as is evidenced by the fact that the Knoxville Iron Company of Knoxville, Tenn., has purchased two such motors for driving merchant mills. Each motor is rated 8-10 poles, 800-800 hp., 900-720 rpm., 2,200 volts, 60 cycles. One of the motors purchased by the Consolidated Rolling Mills Company to replace an engine drive is a two-speed motor rated 8-16 poles, 500-250 hp., 750-375 rpm., 3,000 volts, 50 cycles.

Such widespread interest has been aroused over the recent starting up of the mercury boiler and turbine at the Dutch Point Station of the Hartford Electric Light Company that, although not applying directly to steel mill power plants, a few comments on this installation may not be out of place. The method applied in this process may be stated briefly as follows: Mercury is vaporized at 35 pounds gauge pressure and 812 deg. F. in a boiler heated by an oil-fired furnace of the ordinary type. From this boiler the mercury vapor passes to the nozzles of a turbine which drives a generator. From this turbine the exhaust at 29-in. vacuum and 414 deg. F. is passed through a mercury condenser, the tubes of which contain water, and this water is vaporized by the heat delivered, and the steam produced may be used to drive other turbines or, as is the case at the Hartford installation, the steam is supplied to the station main. In this way advantage is taken of a much greater temperature range than is possible with steam alone and a kwh. may be generated on about 11,000 Btu.

There has recently been put in operation at the plant of the Allegheny Steel Company, Brackenridge, Pa., the largest electric induction furnace of the single horizontal ring type in this country. This furnace will be used principally to melt high silicon sheet steel scrap, now almost worthless, and produce ingots for the manufacture of high grade transformer steel. During the three weeks following the starting of the furnace, approximately 250 tons of high quality steel were produced, which showed a very low hysteretic loss. As the 60-cycle frequency of the power circuit is too high for an induction furnace of this capacity, a motor-generator set is used consisting of a 1,400-kva. (.8 P.F.), 3-phase, 60-cycle synchronous motor driving a 2,000-kva. (.4 P.F.), single-phase, 8½-cycle generator to transform from the 3-phase, 60-cycle power to the single phase, 8½-cycle power. The normal holding capacity of the furnace is 12,000 pounds of molten metal and under normal conditions a 3½-ton heat should be poured at least every five hours. Under such conditions the power consumption will be approximately 650 kwh. per ton or lower. On account of lack of proper methods of handling and charging sheet steel scrap, it has not been possible to run the furnace at its normal capacity of 800 kw., 550 kw. being the maximum to date, which means long heats and high energy consumption, the lowest to date being 720 kwh. per ton. It is confidently expected that as soon as the operators have become thoroughly accustomed to this furnace, a number of records will be established, both from the standpoint of economical conversion of this scrap material and high quality of product.

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Improvements in Rotors

By J. E. FRIES

UNDER date of March 15, 1921, one of our active engineering members, Mr. J. E. Fries, was granted a patent No. 1,371,233 covering a new and useful improvement in rotors for squirrel cage motors and methods for securing the winding thereto.

The present invention relates to the method of forming and securing the winding on the rotors of squirrel cage induction motors and to producing a rotor of improved construction in which screws and other mechanical joints are dispensed with in securing the winding in place. A further feature of the invention is the improved construction of the end rings and the inexpensive method of forming them by electrically spot-welding several duplicates of the punchings of which the laminated rotor is constructed.

The object and advantages of the invention will be apparent from the following specification and particularly pointed out in the subjoined claims.

Ever since squirrel cage induction motors first came into use, many different methods of short circuiting the copper conductors threading the slots of the rotor have been devised and tried with more or less success. The copper conductors have been fastened to end-rings by means of screws, rivets or solder. It has been tried to cast conductors and end-rings in one operation in their proper place, forming a grill work of copper without joints interlinking the iron circuit. This method was abandoned as impractical and too expensive. Electrically welding the conductor to the end-rings is now extensively in use, but is expensive, and is not wholly satisfactory, because of the tendency for the bars to break off at the point of connection with the end-rings, due to change in cross-section and to repeated changes in temperature. Screws fall out and rivets loosen until contact surfaces corrode, overheating and ultimately sparking and burning occur.

In all these cases the conductors extend outside of the slots through the rotor-laminae and with their attached end-rings rotate in the air, producing a fan effect which forms an essential part of the cooling system of the motor.

This invention provides a rotor having a squirrel cage winding which is secured in place without the use of numerous soldered, welded, cast or other joints such as obtained by the use of screws, rivets or the like.

J. E. FRIES.

ROTOR FOR SQUIRREL CAGE INDUCTION MOTORS AND METHOD OF SECURING THE WINDING THERETO.

APPLICATION FILED AUG 21, 1918.

1,371,233. **Patented Mar. 15, 1921.**

Fig. 1.

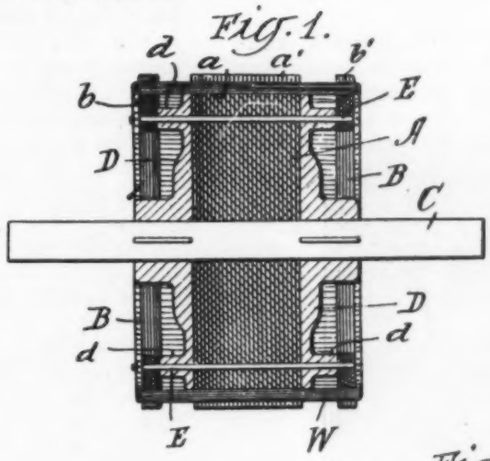

Fig. 2.

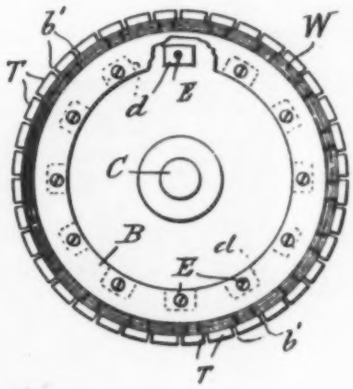

Fig. 3.

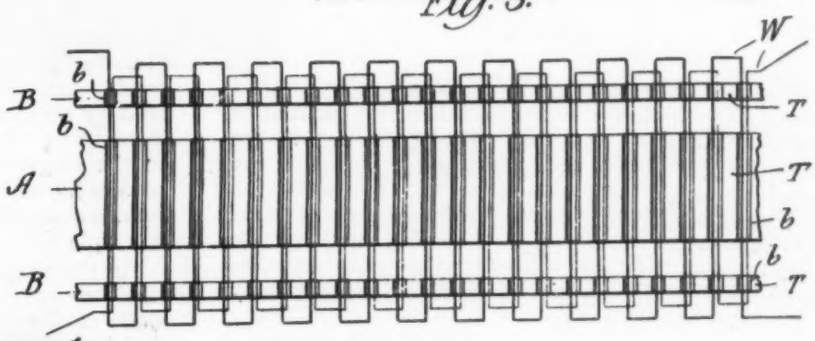

FIG. 7

Fig. 4.

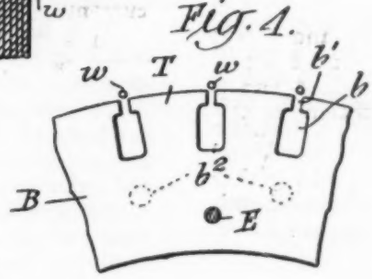

Fig. 5.

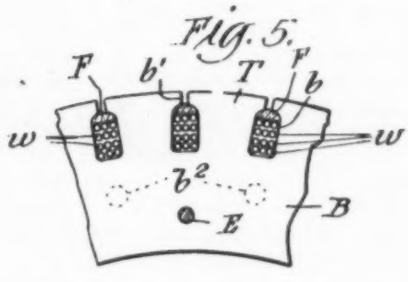

Fig. 6.

INVENTOR
Joens E. Fries
BY
Anthony Usina, ATTORNEY

Referring to the drawings in which like characters refer to like parts in the several views.

Fig. 1 is a central longitudinal section of a rotor built in accordance with my invention, the winding being shown somewhat diagrammatically and certain wedges being omitted.

Fig. 2 is an end view of Fig. 1.

Fig. 3 is a diagrammatic development of the periphery of the rotor and end-rings illustrating the method of applying the winding.

Figs. 4 and 5 are fragmentary detail views on an enlarged scale showing the end-rings before and after the winding is secured in place.

Fig. 6 is a plan of a portion of one of the end-rings partly broken away to show the spot-weld securing the adjacent laminae.

Fig. 7 is a detail illustrating one of the wedges for securing the winding in place.

The rotor consists essentially of a drum A, end-rings B and a rotor shaft C. The drum and end-rings may be either solid or laminated as shown. In the

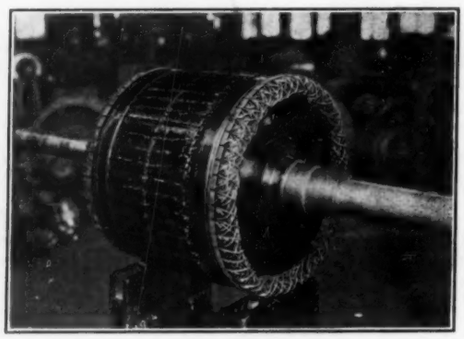

FIG. 8.

construction shown the drum laminae are positioned by heads D which are keyed or otherwise secured in place on the rotor shaft C. The end-rings B are spaced away from the drum by lugs d formed on the heads D, and are secured in place by thorough-bolts E. These bolts also pass through suitable apertures in the laminae of the drum, thus serving to clamp the laminae of the drum and the end-rings firmly together and also to aline the slots a and b formed respectively in the drum and end-rings.

The end-rings B are conveniently made up from punchings that are duplicates of those employed in forming the laminated drum A, therefore the slots a, b of all the laminae are identical in size and shape. The outer ends or throats of the slots a and b are of reduced size as shown at a', b' in Figs. 1, 4 and 5, the width of these throats being just sufficient to permit of the passage of the copper conductors w forming the winding W. The laminae of both the drum A and end-rings B of the rotor are securely clamped together by the bolts E so as to form a single structural unit having alined slots therein which are adapted to receive the squirrel cage winding.

The winding W is secured in place by passing the wire or wires thereof back and forth longitudinally (as shown in Fig. 3) around the teeth T formed in the rings and the drum between the adjacent slots. The winding used is a copper conductor w of such diameter that it can freely pass through the throats a', b' of the slots a and b formed in the drum A and the rings B. When winding, the wire W is passed through the throats a' b' from above without the necessity of threading it through the slot as would be the case if the slots were closed. The wire is then simply bent around one tooth T in the laminae, inserted in the next slot, and so on in sinuous or "zig zag" fashion around the rotor. With an odd number of slots each succeeding wire in any slot will thread that slot in opposite direction, thus making a closed squirrel cage winding as shown. All necessary crossings of wire take place between the slots on the outer sides of the rings as shown in Fig. 3.

In order to secure the necessary ventilation parts of the conductors are exposed to the air, as in conventional designs. For this purpose the two rings are held as shown in Fig. 1 in spaced relation from the main body of the rotor by the lugs d. These rings have slots b similar to and in alinement with the slots in the rotor laminae. The rings may be made of solid metal, may be made separate, or they may form a part of the heads D which clamp the laminae together; however, these rings for the sake of economical production are preferably built up of a few duplicates of the rotor laminae, so that they already have the slots punched therein. The centers of these laminae are punched out by using some standard blanking die in the factory, so as to admit air between the rings and the main rotor body. In order to stiffen these rings against the pull of the winding the laminae in said rings are spotwelded together in several places, as shown at b^2 in Figs. 4, 5 and 6. The conductors bridging the gap between the rotor drum and the rings serve the customary purpose of fan blades and the spacers d between the ringe and the heads D contribute to the fan effect.

When the slots in the drum A have been filled by the copper wire to the desired extent, hard wood or fiber wedges F are driven into the slots on top of the conductors, thus aiding the overhanging teeth T in holding them tight in the slots and preventing them from being thrown out through the narrow throats. In the rings, steel or copper wedges, F', Fig. 7, are preferably used, as such wedges may be prevented from dislocation axially by turning over their projecting ends f.

In the rings, there can be no objection to filling the small spaces between the wires, the wedges and the walls of the slots with hard solder, as this will make the design more compact mechanically and does not introduce any soldered joints transverse to the path of current.

If a high resistance winding is desired, it may easily be secured by employing phosphor-bronze wire or wire of other alloys.

A squirrel cage rotor constructed as above described and wound in the manner set forth does away entirely with the necessity of using numerous soldered, welded, riveted or screwed joints and overcomes many of the practical difficulties encountered in the use of rotors of this class. It is believed that the method of applying the winding and securing it in place on the rotor is broadly new as are also the several structural features set forth and particularly pointed out in the appended claims.

1. A rotor for induction motors comprising a drum portion, rings spaced away from but secured to said drum, the drum and rings having longitudinal-

ly extending slots formed therein and a winding seated in said slots and passing around the teeth formed between the slots.

2. A rotor for induction motors comprising a drum portion, rings spaced away from but secured to said drum, the drum and rings having registering slots formed therein and a winding passing through said slots and wound around the ends of the teeth formed between the slots in said rings.

3. A rotor for induction motors comprising a drum, rings spaced away from but secured to said drum, said drum and rings having alined slots formed therein and a winding comprising a continuous wire passing sinuously through adjacent slots in the rotor and rings substantially as described.

4. In a rotor for squirrel cage induction motors, end-rings spaced away from the body of the rotor having slots formed therein to receive the winding, said rings being electrically spot welded to one another

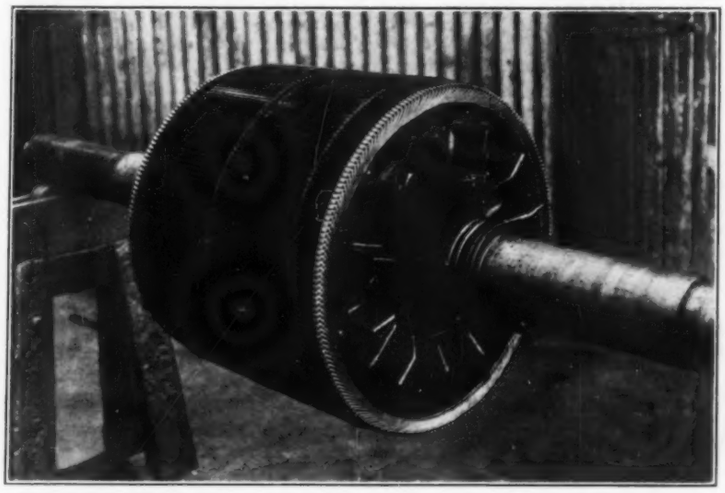

FIG. 9.

and formed of duplicates of the laminae of the rotor with their centers removed.

5. A rotor comprising a drum formed of slotted laminae, end-rings formed of similarly slotted laminae, heads engaging the ends of the drum and provided with lugs engaged by the end-rings and serving to space them from the drum and means passing through said lugs for securing said parts together in the positions stated.

Mr. Fries contributes the following in connection with this patent:

Referring to photograph (Fig. 8), which shows this winding applied, in a rough way, in our repair shop to a two-pole, 25-cycle induction motor. We previously had the General Electric winding with squirrel cage bars welded to the copper end rings. Crystallization, however, set in and the bars broke where welded to the end rings. No difficulty, however, has been experienced with the motors as repaired.

Referring to photograph (Fig. 9), which shows a squirrel cage rotor as manufactured by the Crocker-Wheeler Company under my patent. You will please notice what a beautiful winding this makes, with no change of cross section whatever in the squirrel cage winding and consequently no tendency for breakage. You can obtain as much and as little end ring resistance as you desire with this winding. It is only a question of the number of slots you skip when passing the wire from one slot to the next. The more you skip the more over-lappings you get in the winding and the less resistance. In a two-pole motor, for instance, where the currents have to travel 180 deg. in the end rings around the rotor a great number of cross connections are necessary, as shown on photograph (Fig. 8). In an 8-pole rotor, on the other hand, where the rotor currents are more subdivided, a less number of crossings is required, as shown on photograph, Fig. 9.

In this method of varying the amount of end ring copper it is best understood by comparing the winding

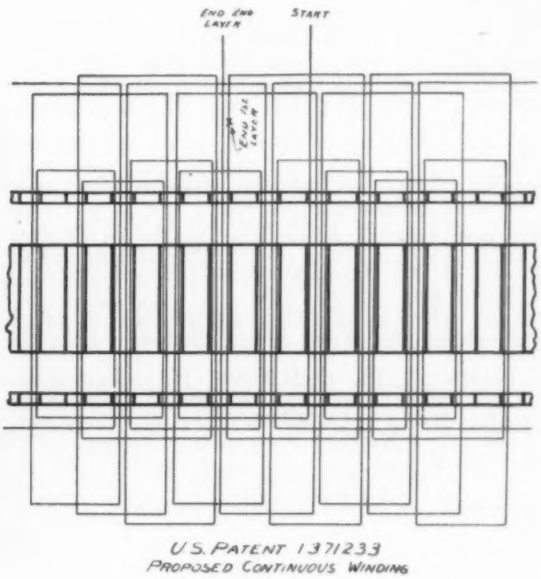

FIG. 10.

shown on Fig. 10 with the diagrammatic winding only which is shown in the patent letters.

When the rotor is wound as shown on the blue print, the wires go straight and parallel to each other through the slots and all crossings take place on the ends of the rotor, whereas if the rotor were actually wound as shown in the patent letters, the crossings would take place inside of the slot and the slots could not be completely filled with copper.

OUR ASSOCIATION

This, the January Number of the Iron and Steel Enginer, is the first issue of our new size periodical.

Each year the progress of the Association has been marked and each step has been a forward one.

In the past few years, our office facilities have been increased several times. Our annual show has grown from one small hotel room in 1919 until now our Exposition is limited in magnitude only by the size of the largest auditoriums available. Our latest step is the increase in size of the official organ of the Association which not more than three years ago was nothing more than a pamphlet.

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McCormick, I. E., Pres., McCormick Lumber Co., McCormick, Wash.
McCoy, James J., Sales Engr., Arrow Electric Co., 608 Chamber of Commerce Bldg., Pittsburgh, Pa.
McCurdy, R. N., Supt. and V. P., Leonard Bundy Elec. Co., 433 Champlain Ave., Cleveland, Ohio.
McShane, Phelan, Steel Mill Section, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
McCutcheon, A. M., Chief Engr., Reliance Elec. & Engr. Co., Cleveland, Ohio.
McDaniel, R. C., 717 Southern Ave., Mt. Washington, Pittsburgh, Pa.
McDowell, Clyde C., Salesman, General Electric Co., 1100 Electric Bldg., Buffalo, N. Y.
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McKean, H. S., Sales Engr., Canadian Gen. Elec. Co., 212 King St., W. Toronto, Canada.
McKelvy, A. B., Salesman, Westinghouse Elec. & Mfg. Co., 1800 Union Bank Bldg., Pittsburgh, Pa.
McGivern, P. J., Dist. Sales Mgr., Trico Fuse Co., 412 State Bldg., Pittsburgh, Pa.
McKinley, Jos., Mgr., Power Sales, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.
McLain, R. H., Railway Dept., Gen. Electric Co., 120 Broadway, New York, N. Y.
McNeely, James C., Light Spec., Western Elec. Co., 910 River Ave., Pittsburgh, Pa.
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Mahaffey, J. K., Mgr. Pgh. Office, Edison Storage Battery Co., 915 Union Arcade, Pittsburgh, Pa.
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Mallalieu, C. Arthur, Lukens Steel Co., Coatesville, Pa.
Maloney, C. J., Br. Mgr., Cutler Hammer Mfg. Co., 1201 Chestnut St., Philadelphia, Pa.
Manbeck, Park D., 1833 Brightwood St., East Cleveland, Ohio.
Mann, S. W., H. Kleinhans Company, 533 Union Arcade, Pittsburgh, Pa.
Mansfield, F. A., Dist. Mgr., The Louis Allis Co. of Milwaukee, Bessemer Bldg., Pittsburgh, Pa.
Marsh, J. D., Westinghouse Elec. & Mfg. Co., Widener Bldg., Philadelphia, Pa.
Marshall, Edw. C., Pres., Alexander Marshall Elec. Co., Washington, Pa.
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Marshall, Stewart M., 1107 Broadway, New York City, N. Y.
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Marvin, Richard H., Elec. Engr., The R. Thomas & Sons Co., East Liverpool, Ohio.
Mason, J. R., Dist. Sales Mgr., The Wickes Boiler Co., 1218 Empire Bldg., Pittsburgh, Pa.
Masterson, T. J., 1701 Clay Street, Oakland, Calif.
Mathews, H. W., Pres., Mathews Elec. Supply Co., Birmingham, Ala.
Matthewson, J., Gen. Supt., Alliance Machine Co., Alliance, O.
Mial, Thomas K., Mgr. Elec. Dept., H. W. Johns Manville Co., Pittsburgh, Pa.
Miller, Gray, 833 E. Hutchinson Ave., Swissvale Branch, Pittsburgh, Pa.
Miller, Wm. J., Sales Engr., Calebaugh Self Lubricating Carbon Co., 1503 Columbia Ave., Philadelphia, Pa.
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Mills, Geo. P., 359 Aylesford Place, Lexington, Ky.
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Morris, A. F., Sales Mgr., The Morgan Engr. Co., Alliance, O.
Morrow, Linn O., Sales Engr., Cutter Elec. & Mfg. Co., Franklin Trust Bldg., Philadelphia, Pa.
Mortensen, W. L., E. E., Cutler Hammer Mfg. Co., Milwaukee, Wis.
Moyer, Charles T., Lub. Engr., Keystone Lubricating Co., Philadelphia, Pa.
Muir, Tom J., Sales Engr., Morgan Engr. Co., Alliance, Ohio.
Mullen, James J., Vice Pres., Maloney Elec. Co., St. Louis, Mo.
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Nichols, H. C., Westinghouse Elec. & Mfg. Co., Widner Bldg., Philadelphia, Pa.
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Norstrum, C. O., Chief Mech. Engr., Keystone Lubricating Co., Philadelphia, Pa.
Oberschmidt, F. H., Sales Eng., Cutler Hammer Mfg. Co., Cleveland, Ohio.

Oeters, Edgar O., Elec., Edgar O. Oeters Co., 605-7 Arch St., Philadelphia, Pa.
O'Neill, H. P., Erecting Engr., Milwaukee Elec. Crane & Mfg. Co., Milwaukee, Wis.
Ostrom, Carlton, P. O. Box 807, Pittsburgh, Pa.
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Parsons, Edmund S., Elec. Eng., Washburn Wire Co., Phillipsdale, R. I.
Pateracki, R. M., Sales Mgr., J. O. Morris Co., 1270 Broadway, New York City, N. Y.
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Patterson, D. B., Sales Engr., Shepard Elec. Crane & Hoist Co., Baltimore, Md.
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Peterson, E. G., Elec. Engr., Cutler Hammer Mfg. Co., 950 Century Bldg., Pittsburgh, Pa.
Pfischner, Theodore, Iron City Electric Co., 436 7th Ave., Pittsburgh, Pa.
Phillips, R. M., Dist. Mgr., Electric Controller & Mfg. Co., Cleveland, Ohio.
Pierce, A. G., Mgr. Central Dist., Cutler Hammer Mfg. Co., 950 Century Bldg., Pittsburgh, Pa.
Piper, A. A., Rep., E. C. Mfg. Co., 620 First Nat. Bank Bldg., Cincinnati, Ohio.
Pirtle, Claiborne, Pres., The Electric Controller & Mfg. Co., 2698 East 79th St., Cleveland, Ohio.
Pittock, L. B., Asst. Supt., Estate of Henry W. Oliver, 232 Oliver Bldg., Pittsburgh, Pa.
Playfair, L. I., Sales Engr., Canadian General Electric Co., Toronto, Canada.
Polster, Fred, Sec., The Industrial Electric Co., Cleveland, Ohio.
Poulterer, W. T., E. E., Electrical Development & Machine Co., Philadelphia, Pa.
Powell, W. H., E. E., Charge D. C. Dept., Allis Chalmers Co,. Milwaukee, Wis.
Poynton, W. P., E. E., Le Carbone Carbon Brush Co., 634 Wabash Bldg., Pittsburgh, Pa.
Pratt, J. M., Asst. Sales Mgr., Rumsey Elec. Co., 1007 Arch St., Philadelphia, Pa.
Price, J. M., Sales Eng., Electro Metallurgical Sales Co., 1714 42nd St. Bldg., New York, N. Y.
Price, John McC., Dist. Mgr., Industrial Controller Co., 53 W. Jackson Blvd., Chicago, Ill.
Price, W. H., Midvale Steel Co., Coatesville, Pa.
Provost, Geo. W., Pres., Union Electric Co., Pittsburgh, Pa.
Purcell, W. H., Pres. and Gen. Mgr., The Alliance Mach. Co., Alliance, Ohio.
Quentin, Geo. W., Sales Engr., Contract Dept. Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.
Ransford, H. E., Sales Engr., W. A. McCombs Co., 310 Union Arcade Bldg., Pittsburgh, Pa.
Ramsey, A. Milne, Sales Eng., 1657 Monadnock Block, Chicago, Ill.
Rasmussen, C., Sales Mgr., Euclid Electric & Mfg. Co., Euclid Village, Ohio.
Rath, James M., Power Plant Elec. Dept., National Tube Co., McKeesport, Pa.
Reeb, C. A., Sales Rep., Kerite Insulated W. & C. Co., 709 Peoples Gas Bldg., Chicago, Ill.
Rei, Harry D., Dist. Sales Mgr., Crouse Hinds Co., 329 Dixie Terminal, Cincinnati, Ohio.
Reichenbach, H. A., Comb. Engr., Fuller-Lehigh Co., Fullerton, Pa.
Renton, Joseph A., Rep., Kerite Insulated Wire & Cable, 30 Church St., New York, N. Y.
Reynolds, Baxter, Dist. Mgr., Allen Bradley Co., 615 Bulletin Bldg., Philadelphia, Pa.
Reynolds, H. Lee., 2112 1st Natl. Bank Bldg., Pittsburgh, Pa.
Rice, C. A., The Mutual Tire & Sales Co., 607 Market St., Youngstown, Ohio.
Richards, Thomas T., Asst. S. M., Wagner Electric Mfg. Co., St. Louis, Mo.
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Riling, F. E., Salesman, Harvey Hubbell, Inc., 608 Chamber of Comm. Bldg., Pittsburgh, Pa.
Robbins, C. C., Pres., Cleveland Crane & Engr. Co., Wickliffe, Ohio.
Roberts, A. L., 442 77th St., Brooklyn, N. Y.
Robinson, W. P., 923 Traders Bank Bldg., Toronto, Ont., Canada.
Roe, Julian, Dist. Mgr., Crocker Wheeler Co., Old Colony Bldg., Chicago, Ill.
Ross, R. Alexander, Coml. Engr., Westinghouse Lamp Co., 1415 Union Bank Bldg., Pittsburgh, Pa.
Ross, E. E., Salesman, Westinghouse Elec. & Mfg. Co., 1803 Union Bank Bldg., Pittsburgh, Pa.
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Russell, S., Jr., 1209 Arch St., Philadelphia, Pa.
Rutherford, B., Consl. Engr., First Natl. Bank Bldg., Pittsburgh, Pa.
Ryan, E. C., 111 West Washington St., Chicago, Ill.
Ryder, H. A., 813 North Eleventh Ave., Maywood, Ill.
Sampson, A. T., Pres., Sampson Axcess System Co., 434 Union St., Lynn, Mass.
Scanlon, J. Leo, J. Leo Scanlon Co., 950 Ellicott Square, Buffalo, N. Y.
Schaum, P. H., Salesman, V. V. Fittings Company, 933 Liberty Ave., Pittsburgh, Pa.
Schertz, W. A., 405 So. Dallas Ave., Pittsburgh, Pa.
Schmidt, Ira W., Sales Rep., Elec. Service Supplies Co., 17th and Cambria St., Philadelphia, Pa.
Schneeberger, C. B., Engr., Cleveland Electric Illumin. Co., Cleveland, Ohio.
Schroder, B. A., Pres., General Machinery Co., Birmingham, Ala.
Schneler, A. A., 1287 Virginia Ave., Lakewood, Cleveland, Ohio.
Schuster, C., Pres., Pittsburgh Elec. & Mach. Works, Barker Place, Pittsburgh, Pa.
Schuster, F. A., Sec., Pgh. Elec. & Mach. Works, Barker Place, Pittsburgh, Pa.
Scott, Gail G., Trav. Salesman, Stackpole Carbon Co., St. Mary's, Pa.
Scott, William L., Gen. Foreman in Elec. Dept., National Tube Co., Lorain, Ohio.
Scott, Wm. M., Engr. and Gen. Mgr., The Cutter Electric & Mfg. Co., 19th and Hamilton Sts., Philadelphia, Pa.
Seede, John A., Elec. Engr., Electric Furnace & Welding Dept., General Electric Co., Schenectady, N. Y.
Siebenmorgen, Wm., Eastern Rep., Corliss Carbon Co., 90 West St., New York, N. Y.
Siegrist, W. C., Gen. Sales, Heine Boiler Co., St. Louis, Mo.
Silbey, E. D., Supt. of Operation, Metropolitan Edison Co., Reading, Pa.
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Slocum, G. Frank, Sec., Doubleday-Hill Electric Co., 719-721 Liberty St., Pittsburgh, Pa.
Smith, E. E., Sales Engr., Morganite Brush Co., 519 W. 38th St., New York, N. Y.
Smith, Frank Asst. Mgr., Otis Elevator Company, Chamber of Comm. Bldg., Pittsburgh, Pa.
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Spellmire, W. B., Salse Mgr., General Electric Co., Oliver Bldg., Pittsburgh, Pa.
Spicer, A. B., Crouse Hinds Co., 258 Frisco Bldg., St. Louis, Mo.
Sprague, F. B., 509 Calumet Ave., Middletown, Ohio.
Spencer, Jr., I. H., The Spencer Turbine Co., Hartford, Conn.
Stack, G. E., E. E., General Electric Co., Schenectady, N. Y.
Stage, R. C., Engr., Calebaugh Self Lubricating Carbon Co., P. O. Box 616, Syracuse, N. Y.
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Stevenson, W. D., 702 Farmers Bank Bldg., Pittsburgh, Pa.
Stevenson, Walter E., 702 Farmers Bk. Bldg., Pittsburgh, Pa.
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Stone, Robert R., Elec. Engr. Duquesne Light Co., 5509 Walnut St., Pittsburgh, Pa.
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Stratton, H. F., Mgr. & Chief Eng., Electric Controller & Mfg. Co., Cleveland, Ohio.
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Sykes, S. B., General Electric Co., 230 Clark St., Chicago, Ill.
Swartz, A. H., Spec. Rep., Westinghouse Elec. & Mfg. Co., Cleveland, Ohio.

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Tinnerholm, August F., Mica Insulator Co., Schenectady, N. Y.
Torrey, C. E., Atlantic City Elec. Co., Atlantic City, N. J.
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Townsent, E. D., Sec., Beckwith Machinery Co., Pittsburgh, Pa.
Tregenza, A. E., Economy Fuse & Mfg. Co., at Diversey Pk., 2725 Greenview Ave., Chicago, Ill.
Tresselt, R., V. V. Fittings Co., Room 550, 50 Church St., New York, N. Y.
Turner, Robt. T., Dist. Sales M., Shepard Elec. Crane & Hoist Co., Montour Falls, N. Y.
Turner, W. M., Elec. Foreman, Atlantic Refining Co., Collingwood, N. J.

Umberger, J. C., Prop., Electrical Constr. Business, 410 Chestnut St., Lebanon, Pa.
Unger, G. A., Cons. Engr., Joseph Dixon Crucible Co., Jersey City, N. J.
Upp, Edwin L., 2141 E. 31st St., Lorain, Ohio.

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Van Kirk, E. P., E. E., Westinghouse Air Brake Co., Wilmerding, Pa.
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Wright, R. I., Electric Controller & Mfg. Co., Cleveland, Ohio.

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Yerger, C. W., Dist. Mgr., Cutler Hammer Mfg. Co., 52 Chauncy St., Boston, Mass.
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Yorkey, W. R., 49 Federal St., Room 825, Boston, Mass.
Young, F. C., Indust. Rep., Westinghouse Tract. Brake Co., 318 Westinghouse Bldg., Pittsburgh, Pa.
Yerger, C. W., Engr., Igranic Eelectric Co., Ltd., London, F. C. 4, England.

Zachau, Eric, Wks. Mgr., Shaw Crane Works, Manning, Maxwell & Moore, Inc., Muskegon, Mich.

POSITIONS WANTED

ELECTRICAL Engineer, 10 years' practical experience with blast furnaces desires to make a change; married; best of references. Write No. 100, c/o Iron and Steel Engineer.

POSITION Wanted as chief electrician or assistant electrical superintendent of industrial plant, steel mill or power house. 12 years of practical electrical experience, in construction, maintenance, 5 years' experience in designing electrical layouts and estimating for steel mills, industrial plants, sub-stations and power houses. Registered electrical engineer. P. O. Box 362, St. Louis, Mo.

POSITION Wanted as mechanical and electrical engineer by technical graduate with 18 years' practical experience in the erection of power houses, installation and maintenance of steel mill machinery; 3 years' experience operating gas engine power generating station. Write No. 101, c/o Iron and Steel Engineer.

POSITION Wanted as electrical engineer by technical graduate with 15 years' experience in the design, installation and operation of steel mills, and 3 years' experience in combustion work. Is employed at the present time by one of the large steel companies but desires a change. Write No. 102, c/o Iron and Steel Engineer.

POSITION Wanted as electrical engineer by a technical graduate with 20 years' experience in the installation, operation and maintenance of electrical apparatus with one of the largest steel companies in the country. Best of references furnished. Write No. 103, c/o Iron and Steel Engineer.

POSITION Wanted by an electric furnace operator who is at the present time employed with one of the largest plants in this country. Is capable of handling not only the electrical application but is able to melt steel. In all, has had about 10 years' experience in the installation and operation of steel mill machinery. Write No. 106, c/o Iron and Steel Engineer.

POSITION Wanted by graduate of Polytechnic Institute who has spent two years with one of the largest electrical manufacturing firms in the country. Is at present employed by one of the large steel companies in their engineering department. Has had a number of years' experience in substation and power house work. Write No. 104, c/o Iron and Steel Engineer.

POSITION Wanted as sales engineer by technical graduate who has formed a very close contact with the steel mill and railroad interests. Has an intimate knowledge of the requirements of railroads, due to his work for the railroads bringing him in contact with practically all of the steel companies throughout the country. Best of references furnished. Write No. 105, c/o Iron and Steel Engineer.

MANUFACTURERS' Agent, calling on steel mills, industrial plants and central stations would like to add a new line of electrical equipment to his present accounts. Is well established in the Pittsburgh District. Write 107, c/o Iron and Steel Engineer.

1922 YEARLY PROCEEDINGS

The 1922 Yearly Transactions of the Association have just been mailed to the membership of the Society.

Due to the increasing demand for copies of these Yearly Issues from non-members, a limited number of extra copies were printed. The contents are as follows:

Power Transmission in Industrial Plants.

Care and Operation of Power Transformers.

Efficient Burning of Fuel and Use of Waste Gases in Iron and Steel Plants.

Value of By-product Gas to Industry.

Fuel Gases and Their Use in Iron and Steel Plants.

The Application of Electric Power in the Iron and Steel Industry.

Electrification of Industrial Plant Railways.

Topical Discussion—Stokers and Their Recent Developments.

Reducing Power Bills on Mine Fans with Synchronous Motors.

Power Systems and the Steel Industry.

Bent Tube vs. Straight Tube Boilers.

Modern Trend of Power Development.

Manufacture of Phosphoric Acid.

Automatic and Remote Controlled Sub-Stations as Applied to Steel Mills.

The Relation of the Engineer to Fuel Conservation.

Electrification of the International Nickel Company's Works for Monel Metal.

Some Considerations in the Electrification of the Steel Plant Railroad Yard.

Generating Station Development.

Judging the Combustion of Gaseous Fuels from Gas Analyses.

Boiler Practices of 1922.

A Review of Steel Mill Electrification.

Electrical Development Committee Report for 1922.

Report of Control Committee.

Report of Sub-Committee on Illumination.

Report of Standardization Sub-Committee on Transmission.

Report of Standardization Sub-Committee on Motors.

Safety Organization—General Safety Rules.

Improvement in Efficiency of Electric Power Supply.

Internal Combustion Engines for Power Generation in Steel Plants.

Steam Turbine Operation.

The Operation of Frequency Changers.

Electrical Power Distribution in the Steel Industry.

Departmental Organization.

Roller Bearings Applied to Mill Motors.

Electric Heating Applied to the Steel Industry.

Improved Rolling Mill Practice Obtained by the Use of Direct Current Motors for Main Roll Drive.

Safety Switches.

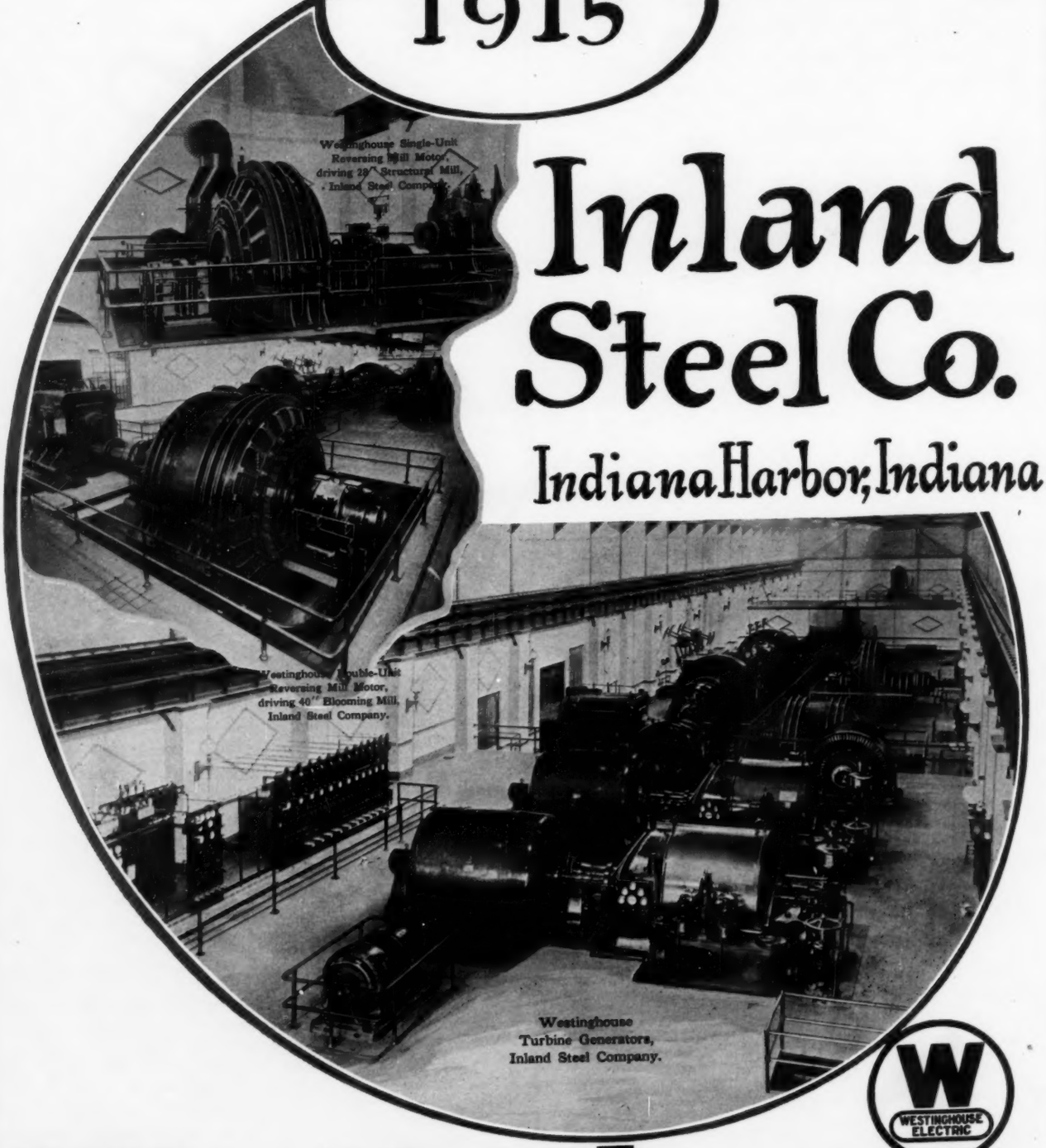
INDIANAPOLIS

and again

1915

Inland Steel Co.

Indiana Harbor, Indiana


Westinghouse Single-Unit Reversing Mill Motor, driving 29" Structural Mill, Inland Steel Company.
Westinghouse Double-Unit Reversing Mill Motor, driving 40" Blooming Mill, Inland Steel Company.
Westinghouse Turbine Generators, Inland Steel Company.

W WESTINGHOUSE ELECTRIC

Westinghouse

in 1923

In further plant extension and improvement, the Inland Steel Company will install the following Westinghouse electrical equipment at Indiana Harbor, Ind.:

1—10,000-kw. Turbine Generator
5—1000-kw. Synchronous Converters
3—1100-kv-a. Transformers
6—367-kv-a. Transformers
1—6250-hp. Induction Motor and Control to drive a 24-inch Morgan continuous billet mill
1—1500-hp. Induction Motor and Control to drive the finishing stand of a sheet bar mill
2—800-hp. A.C. Motors and Control
1—250-hp. A.C. Motor and Control
1—250-hp. D.C. Motor and Control
1—14-panel Switchboard, D.C.
1—14-panel Switchboard, A.C.
14—A.C. Primary and Feeder Panels

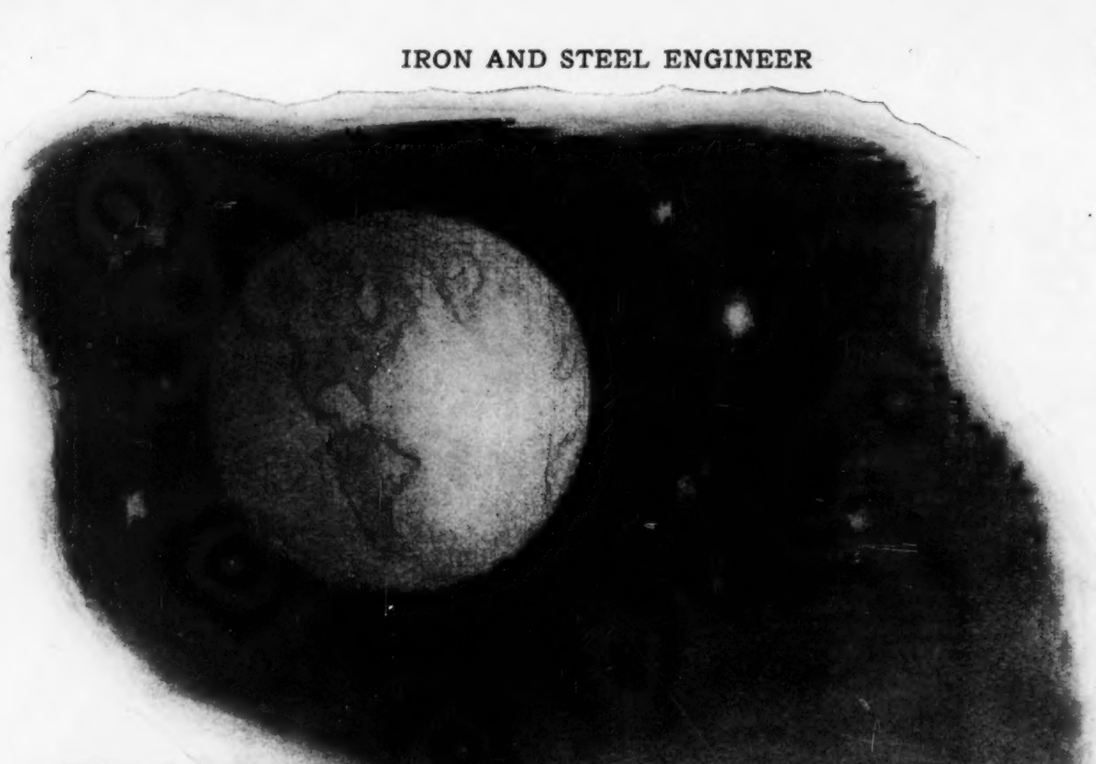
This equipment, which is now on order, supplements our previous installation in the Indiana Harbor plant in the year 1915.

Westinghouse engineers will be glad to co-operate with you on any electrical problem.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

W
WESTINGHOUSE ELECTRIC

Westinghouse



World Standards Changing—

Old ideas on the life of machinery—on the cost of maintenance—on sustained efficiency—on dependability—are being replaced by the high standards electric drive itself has established.

A noteworthy case is the two 1500 hp. direct current mill type motors installed 18 years ago in the Edgar Thompson plant of the Carnegie Steel Company.

Without a point's decline in efficiency and without a break-down chargeable against them, they have operated the entire period with a total cost of less than 50 cents a day each for maintenance—including labor.

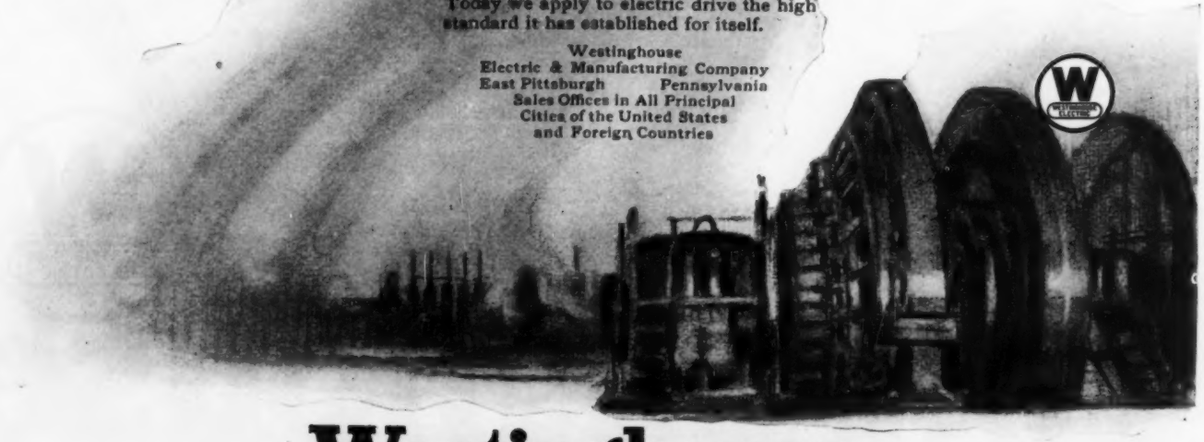
The probable life of the motors is also an important development. Deterioration has been so slight that they are expected to operate another 18 or 20 years with the same satisfaction and efficiency.

That the customer looks forward to many more years of useful service is confirmed by the recent installation of complete automatic control to replace the original hand control.

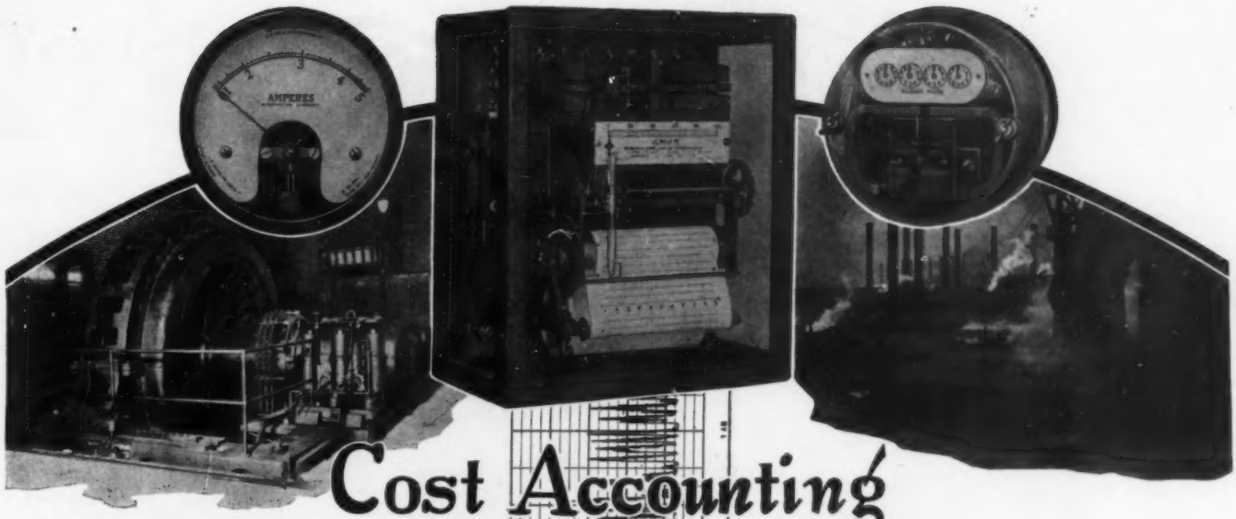
The advance in design, the improvement in materials, and the valuable knowledge acquired of steel mill applications since this pioneer installation was made, give additional assurance of dependable service and long life of equipment.

After thinking in terms of steam from the very beginning of the steel industry, the tendency to apply the language of steam to electrical apparatus is only natural. Today we apply to electric drive the high standard it has established for itself.

Westinghouse
Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal
Cities of the United States
and Foreign Countries



Westinghouse



Cost Accounting —Electrically

Know accurately how much power is consumed in every department—in every process—every day of the year—every hour of the day—by the use of electrical instruments.

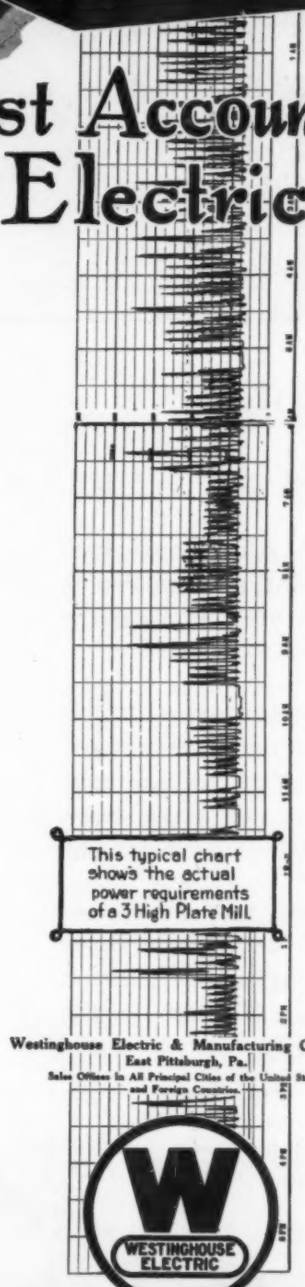
Record the facts over long periods by means of graphic recording instruments.

Observe the momentary fluctuation of the indicating instrument and you know exactly, any time of the day, the existing conditions in the electrical circuits.

Run down every inconsistency—trace all troubles to their source. Know ***where,*** and ***when,*** and ***why,*** every kilowatt of power is used.

Have these indicating and graphic records before you and you know the exact relation of the cost of power to steel production. Electrical instruments decide all controversies justly —in accordance with fact. They leave no room for dispute.

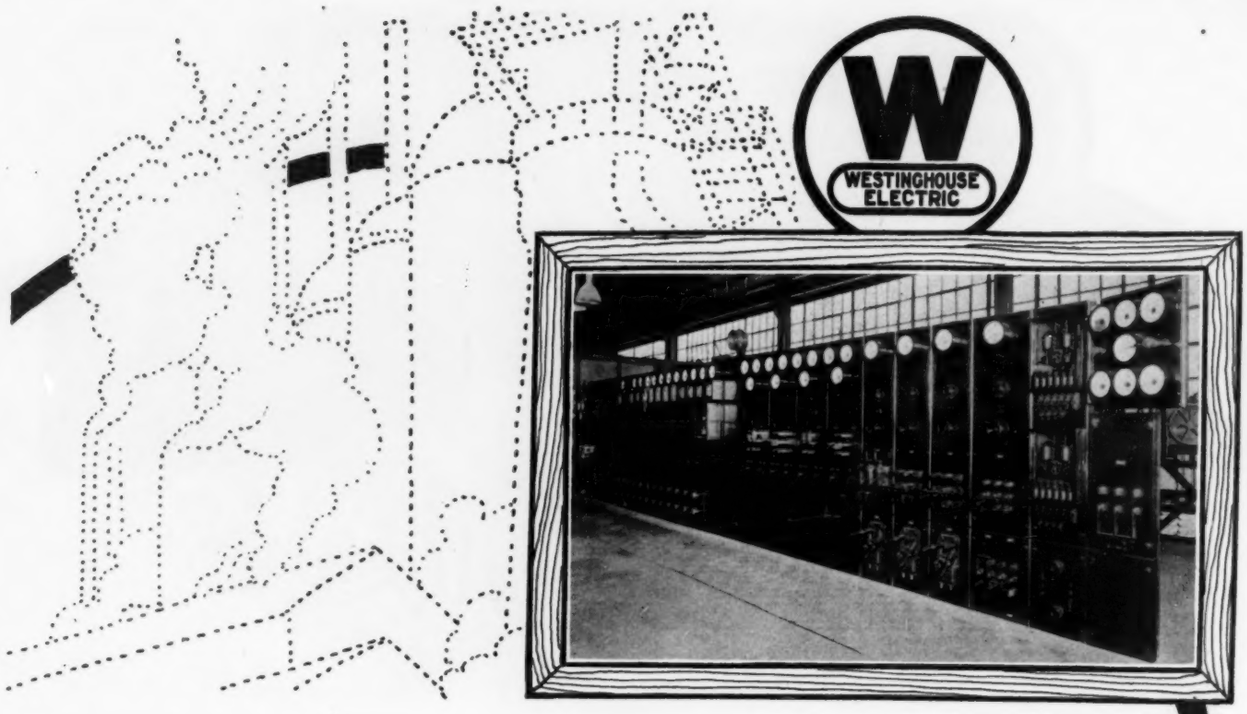
In accurately determining costs, and in establishing better rolling schedules and best mill practice, Westinghouse electrical instruments are an invaluable aid.



Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.
Sales Offices in All Principal Cities of the United States and Foreign Countries

W
WESTINGHOUSE ELECTRIC

Westinghouse



At the Indiana Harbor Plant of the Youngstown Sheet & Tube Co.,

formerly known as the Mark Manufacturing Company, you will find a large Westinghouse switchboard located in the main power house.

This installation is representative of the wide scope of Westinghouse switchboard engineering. Continuity of service and safety to life and property have been assured by careful attention to all details.

This switchboard controls two 6250 kv-a. and three 12,500 kv-a., 2300 volt, three phase, 25 cycle Westinghouse Turbine Generators, Exciters and Feeders to the various mill substations.

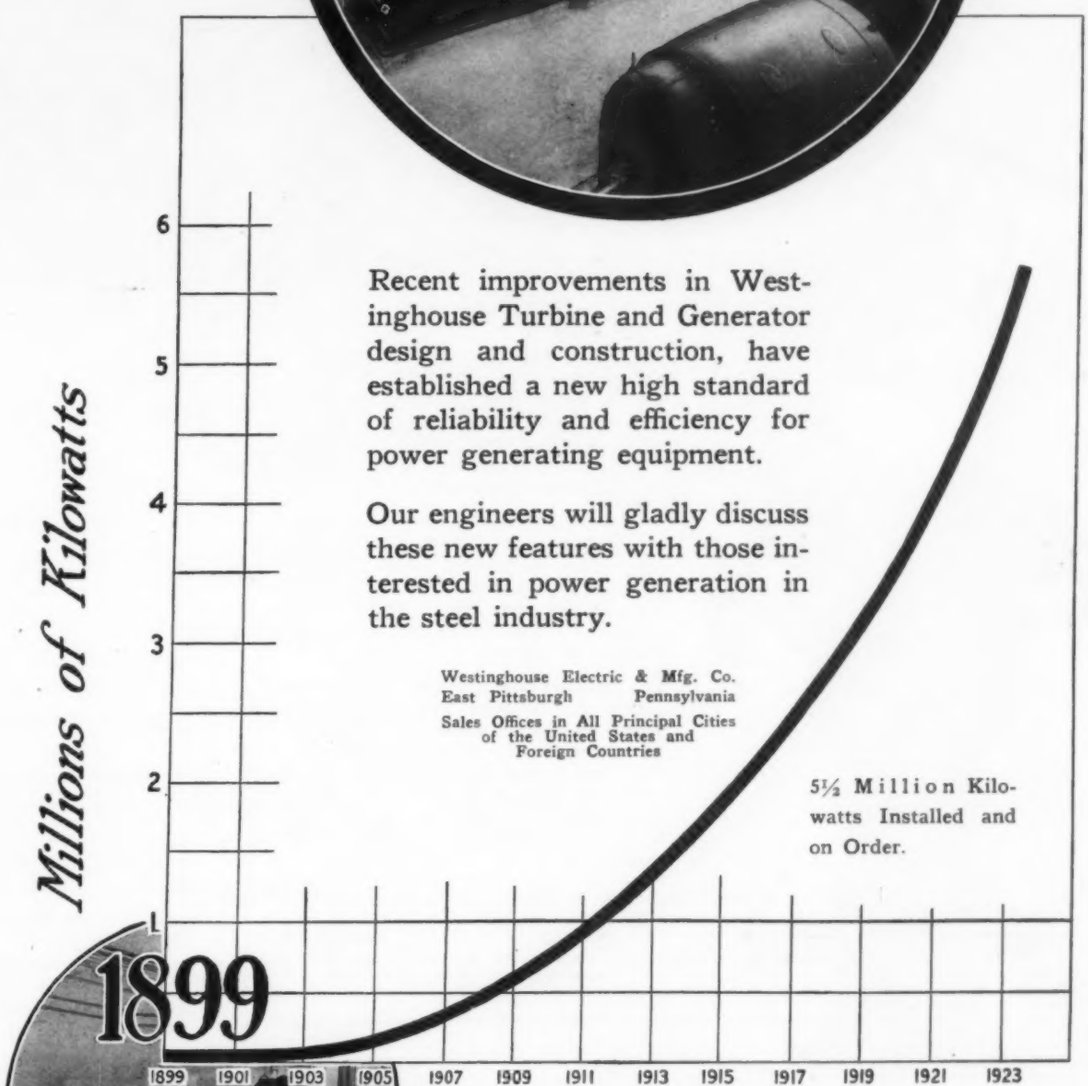
Westinghouse Electric & Mfg. Co.
East Pittsburgh Pennsylvania

Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse

Yearly Increase in the Use of Westinghouse Turbine-Generators

Two 3000-kw. and one 1500-kw. Westinghouse Turbine-Generators in the plant of Follansbee Brothers, Toronto, Ohio.



Recent improvements in Westinghouse Turbine and Generator design and construction, have established a new high standard of reliability and efficiency for power generating equipment.

Our engineers will gladly discuss these new features with those interested in power generation in the steel industry.

Westinghouse Electric & Mfg. Co.
East Pittsburgh Pennsylvania

Sales Offices in All Principal Cities of the United States and Foreign Countries

5½ Million Kilowatts Installed and on Order.

Westinghouse

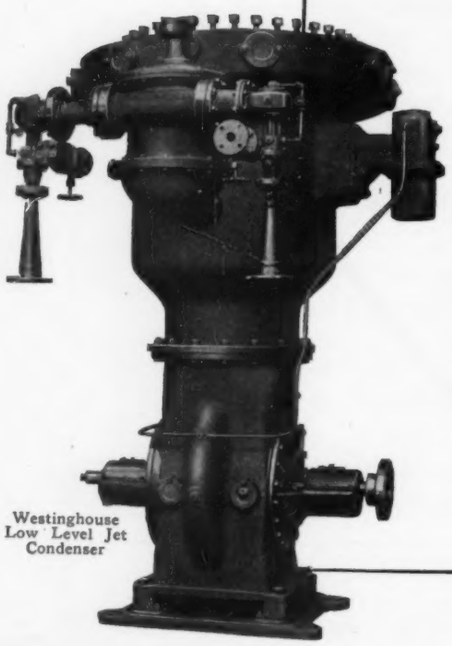
Low Level Jet Surface *and* Barometric Condensers

Westinghouse Surface Condenser

Fully realizing that the maximum in application refinement is just as essential to the highest economy as good design, construction and workmanship, Westinghouse builds all three types of condensers—Surface, Low Level Jet and Barometric.

In the ability to economically maintain high vacuum, Westinghouse condensers are unexcelled. And in order to best meet individual plant requirements, they may be equipped with either the steam jet air ejector or the Leblanc air pump.

The present high standard of condenser performance has been established by the operation of Westinghouse condensers in the leading central stations of the country. Steel mills and industrial plants are taking advantage of this new standard of performance to effect higher power house economies.



Westinghouse Low Level Jet Condenser

Westinghouse Electric & Manufacturing Co.
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of the United States and Foreign Countries

Westinghouse Equipment

—Turbine Generators

—Surface, Low Level Jet and Barometric Condensers

—Small Turbines for pump and fan drive

—Underfeed, overfeed and Chain Grate Stokers

—Power and distribution Transformers

—Water Wheel Generators

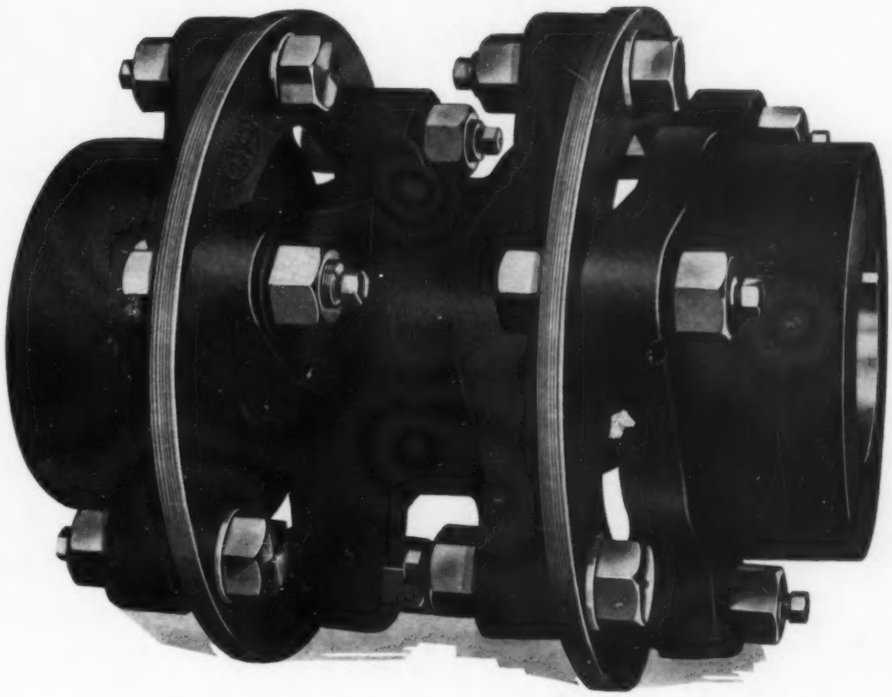
—Motor Generator Sets and Converters

—Switchboards and Protective Apparatus

Westinghouse

THOMAS FLEXIBLE COUPLINGS

FOR HEAVY DUTY ROLLING MILL SERVICE



Standard No. 15 M Mill Type Coupling, driving 100" Plate Mill National Enameling & Stamping Co., Granite City, Ill.

Coupling shown is one of a standard line of all steel mill type couplings, designed especially for main roll steel mill drives.

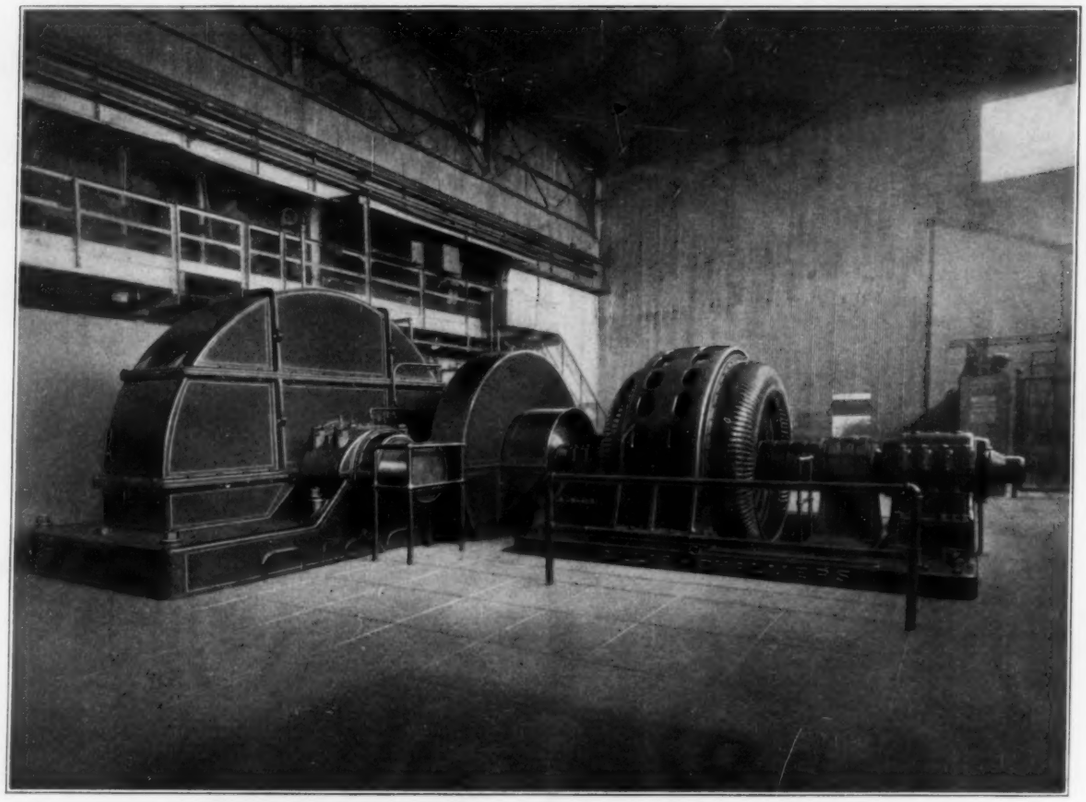
Note that coupling can be completely dismantled without moving either connected shaft in any direction.

Mail Us Your Flexible Coupling Requirements.

THOMAS FLEXIBLE COUPLING CO.

MAIN OFFICE AND WORKS—WARREN, PA.

Sales Offices: New York, Chicago, Cleveland, Philadelphia, Pittsburgh, Boston, St. Louis



Steel Mill Motor Establishes New Record

Consistently and continuously since its installation this large motor has broken all tonnage records.

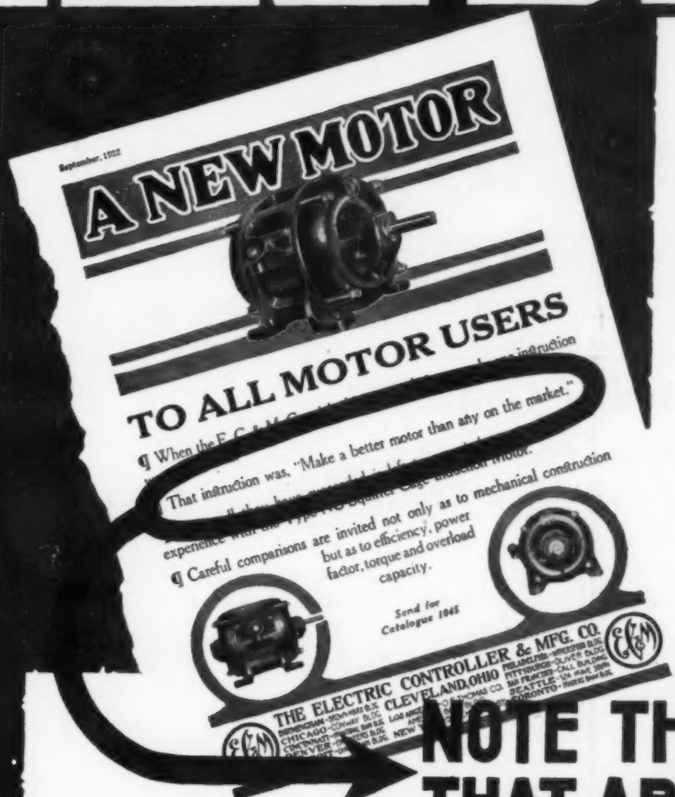
Rated 5000 H.P., 6600 volts, 595 R.P.M., it is the largest motor in steel mill service operating at this high speed.

This equipment is the product of the Allis-Chalmers organization which is ready to serve you not only in steel mill electrification, but in any power problem.

PRODUCTS:
Electrical Machinery
Gas Engines
Steam Engines
Steam Turbines
Condensers
Oil Engines
Hydraulic Turbines
Pumping Engines
Centrifugal Pumps
Mining Machinery
Metallurgical Machinery
Crushing Machinery
Cement Machinery
Flour Mill Machinery
Saw Mill Machinery
Air Compressors
Air Brakes
Steam and Electric Hoists
Farm Tractors
Power Transmission Machinery

ALLIS-CHALMERS
MILWAUKEE, WIS. U. S. A.

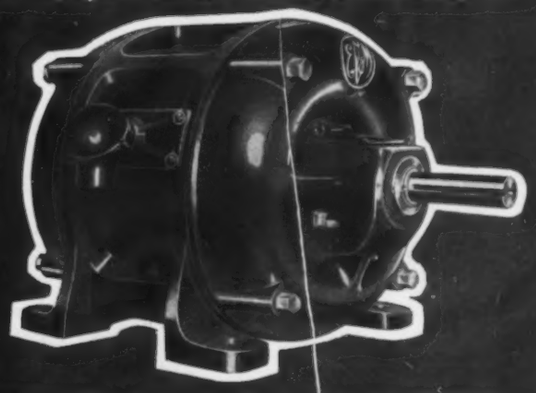
HERE IS PROOF


A NEW MOTOR
TO ALL MOTOR USERS
That instruction was, "Make a better motor than any on the market."
Careful comparisons are invited not only as to mechanical construction but as to efficiency, power factor, torque and overload capacity.
Send for Catalogue 1045
THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, OHIO

A YEAR AGO IN SEPTEMBER THE FIRST TYPE NC SQUIRREL CAGE INDUCTION MOTORS WERE SOLD AND DELIVERED. THE FIRST ADVERTISEMENT IS SHOWN HERE.

NOTE THE SENTENCE THAT APPEARED THEN

DURING THE PAST 16 MONTHS TYPE NC MOTORS HAVE BEEN BUILT AND PUT IN TO THE HARDEST SERVICE, IN MANY CASES WHERE OTHER MOTORS HAD FAILED, AND



NOT A MOTOR HAS FAILED

THE ELECTRIC CONTROLLER & MFG. CO.

BIRMINGHAM - BROWN-MARX BLDG.
CHICAGO - CONWAY BLDG.
CINCINNATI - 1ST NATIONAL BANK BLDG.
DENVER - 3535 WALNUT ST.
DETROIT - DIME BANK BLDG.
CLEVELAND, OHIO
LOS ANGELES - O. E. THOMAS CO.
BOSTON - 49 FEDERAL ST.
NEW YORK - 50 CHURCH ST.
PHILADELPHIA - WITHERSPOON BLDG.
PITTSBURGH - OLIVER BLDG.
SAN FRANCISCO - CALL BUILDING
SEATTLE - 524 1ST AVE. SOUTH
TORONTO - TRADERS BANK BLDG.

"LE CARBONE" CARBON BRUSHES

Standard of Quality and Uniformity

They are supplied not alone to suit type of machine, but your operating conditions.

Guaranteed Without Argument.

Real Engineering Service.

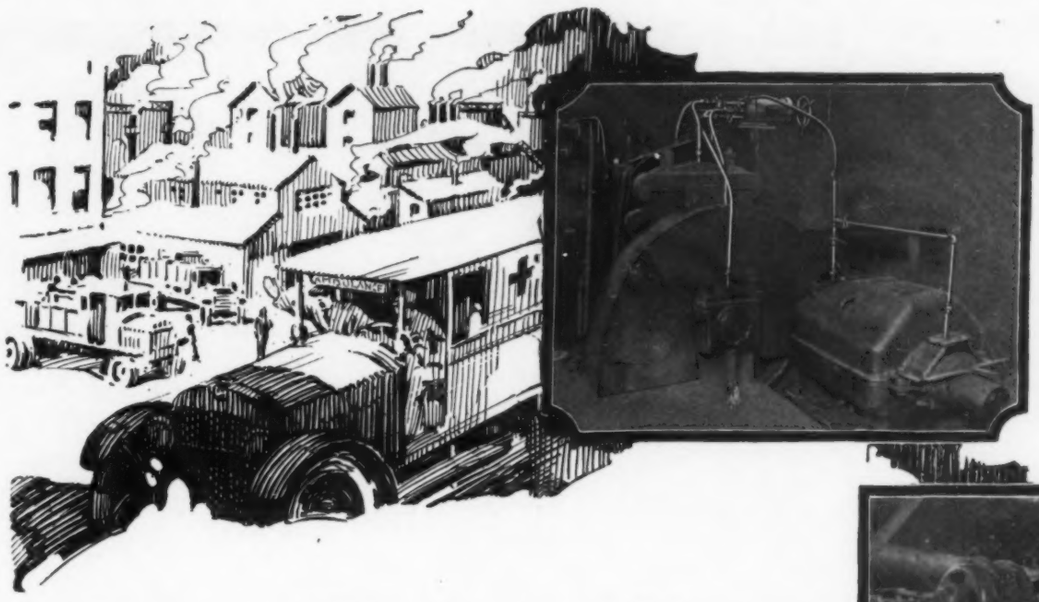
W. J. Jeandron, 345 Madison Ave., New York

Pittsburgh Office, 634 Wabash Bldg.
W. P. POYNTON, Electrical Engineer

San Francisco Office, 525 Market St.
W. R. CATCHING, Sales Engineer

Chicago Office, 1657 Monadnock Block
A. M. RAMSEY, Sales Engineer

Canadian Distributors: Lyman Tube & Supply Co., Ltd.
Montreal and Toronto

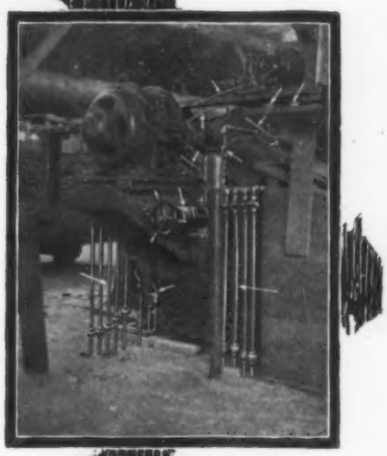


Here are a few of the many Keystone Manifold Safety Lubricator installations.

(a) On cold scrafing machine, as well as Westinghouse motor bearings. (b) Crane installations. (c) Cabinet planer. (d) Industrial locomotive.

KEYSTONE GREASE

A



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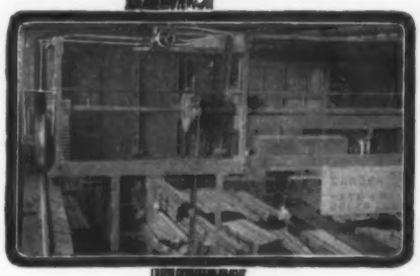

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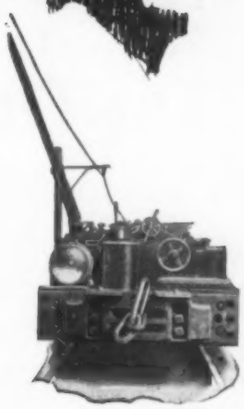


D

Insurance will not save this man

AN insurance policy, while it provides compensation, does not provide safety:—it cannot protect the "oiler" or prevent accidents. You can doubly insure your "oiler" by building the best insurance—safety insurance—right into your machinery.

The hazards—the risks—attending the efficient lubrication of hard-to-reach, inaccessible bearings has been minimized — overcome. With the Keystone Manifold Safety Lubricator, the operator stands at one safe, convenient place and, turning a wheel, lubricates the bearings positively — efficiently — economically.

This is but one of many features that has won instant acceptance for this Keystone high pressure grease lubricating system with engineering authorities everywhere. It minimizes lubrication neglect; keeps dirt, grit, and their abrasive action, out of the bearings; overcomes waste of lubricants; as well as interrupted production while lubricating.

Our free booklet gives details — write!

THE KEYSTONE LUBRICATING CO., PHILADELPHIA
at 21st & Clearfield Streets *Branches Everywhere*

Keystone Manifold Safety Lubricator

MULTIPLE FEED, HIGH PRESSURE GREASE LUBRICATING SYSTEM

OHIO
LIFTING MAGNETS

Reprinted from

16 INDUSTRIAL HANDLING *October, 1923*

Magnets Save Steel-Plant Labor

The lifting magnet that enabled the Otis Steel Company of Cleveland to release 70 loaded cars, empty in 24 hours.

WHEN Judge Gary committed the United States Steel Corporation to an eight-hour day for labor, he made the statement that the improvement would require 60,000 additional laborers for the industry. Because the steel business always has been able to get cheap labor, it has been criticized for neglecting to develop the labor-saving side of its operations to the fullest extent. Doubtless it would also have been criticized if it had so dispensed with some of its labor.

There is one type of material-handling equipment, however, which is not only put to intensive use in the steel industry, but is peculiarly adapted to the characteristics of that business; and that is the lifting magnet. This device has the interesting ability to make the load perform part of the work, by reason of the magnetic nature of steel and iron.

During the war the Otis Steel Company of Cleveland, O., had more than 70 cars in the yard loaded with pig iron and scrap, and was ordered to release these cars empty, within 24 hours. The company had one magnet in operation for loading, and, when the order came, rented a second magnet—the one shown in the picture. With this equipment the government order, seemingly a difficult one, was easily met.

The lifting magnet will usually repay its full cost in a year or less.

The Ohio Electric & Controller Co.
Cleveland, Ohio

OR ASK OUR REPRESENTATIVE

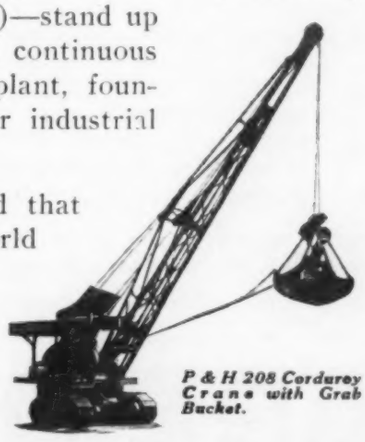
Arthtur H. Abbott, 88 Broad St., Boston, Mass.
Hunter L. Betts, 405 So. Franklin St., Syracuse, N. Y.
K. I. Clisby, Woolworth Bldg., New York City.
S. G. Elbe, 211 Tramway Bldg., Denver, Colo.
G. H. Armstrong, 307 First National Bank Bldg., Cincinnati, O.
Holden Company, Ltd., 350 St. James St., Montreal, Canada; 342 Adelaide St., West Toronto, Canada; 150 Princess St., Winnipeg, Canada; 81 Pender St., West, Vancouver, B. C.
Carl Johnson, 331 Houseman Bldg., Grand Rapids, Mich.
A. S. Lindstrom, 111 New Montgomery St., San Francisco, Cal.
Charles J. Mundo, 380 Union Trust Bldg., Pittsburgh, Pa.
Linn O. Morrow, 707 Franklin Trust Bldg., Philadelphia, Pa.
Nixon-Hassele Co., Chattanooga, Tenn.
J. R. Petree, 1435 Marine Trust Bldg., Buffalo, N. Y.
Southern Industrial Engineering Co., Birmingham, Ala.
C. H. Stem, 518 Conti St., New Orleans, La.
W. H. Williams, 53 West Jackson Blvd., Chicago, Ill.
C. E. Wise, General Motors Bldg., Detroit, Mich.
T. E. Beasley, 617 Bank of Commerce Bldg., St. Louis, Mo.

P & H CRANES

Since the first three-motor electric traveling crane was built—in the P & H shops 30 years ago—there has always been one big outstanding feature—Dependability. And this applied to both the product and the company. P & H Cranes—(over 7,000 in use)—stand up under the most severe and continuous service, whether in steel plant, foundry, railroad shop or other industrial plant.

We are firmly convinced that there is no crane in the world capable of steadier, more dependable performance.

P & H quality of design and construction—the care in selection of all materials—such extra efforts as the re-rolling of all plates in our own plant—our "renewal from stock" service—and standardization—insure the added service and dependability that you get when you buy P & H Cranes.



P & H 208 Corduroy Crane with Grab Bucket.

The fact that the buyer never needs to justify his selection is an indication of how the industrial man and engineer look upon P & H Cranes.

Crane and Hoist Division

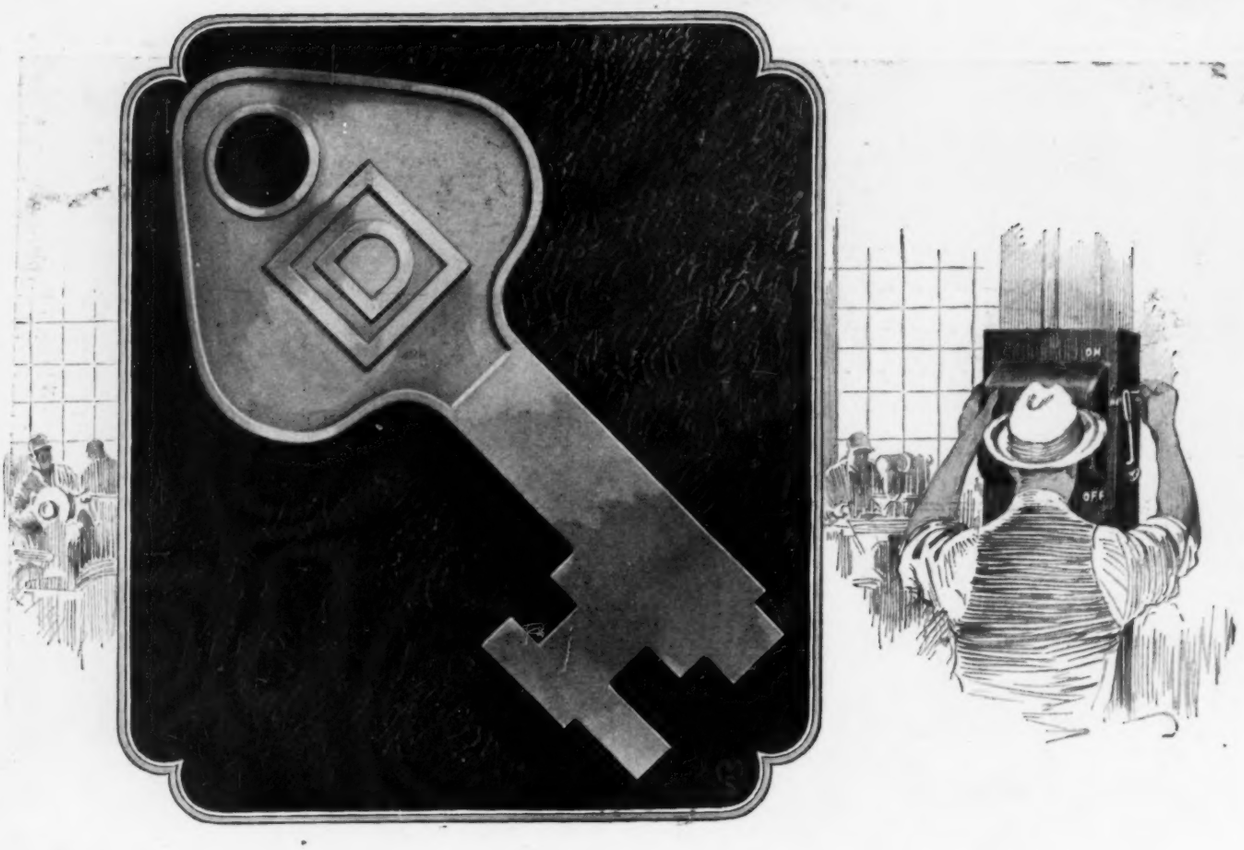
Pawling & Harnischfeger Co.

Established in 1884

3855 *National Ave., Milwaukee, Wis.*

New York	Chicago	St. Louis
Pittsburgh	Philadelphia	Birmingham
Phoenix	Denver	New Orleans
Los Angeles	San Francisco	Atlanta
Salt Lake City	Portland	Seattle

P&H CRANES and HOISTS



Locked when the current is on-
and only the Key can open it

Here is genuine Safety:

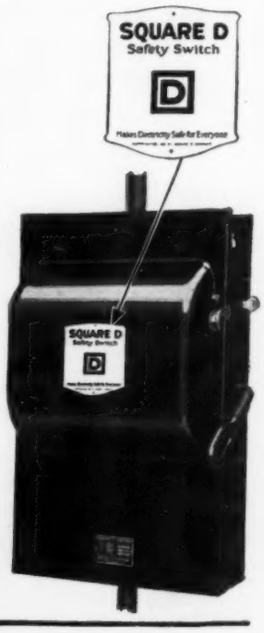
Carelessness, ignorance, even deliberate tampering, are alike helpless to cause injury or accident when a Square D Safety Switch is used.

Anyone can throw the switch when the cover is closed. Anyone can open the cover when the current is off. But no one can open the cover when the current is on—unless he has the Square D Key.

Thus, while inspections can be made while the current is on without interfering with production—they can only be made by the man who has authority to do so. Because the Square D Keys are furnished on order, only to authorized employees.

Square D Safety switches are made in all sizes and types for both industrial and residential use. If you are interested in seeing the newest, safest and easiest-to-install safety switch, write our nearest office. A representative will be glad to demonstrate its numerous advantages.

This shield distinguishes the Square D switch from its imitations. Look for it before you buy.

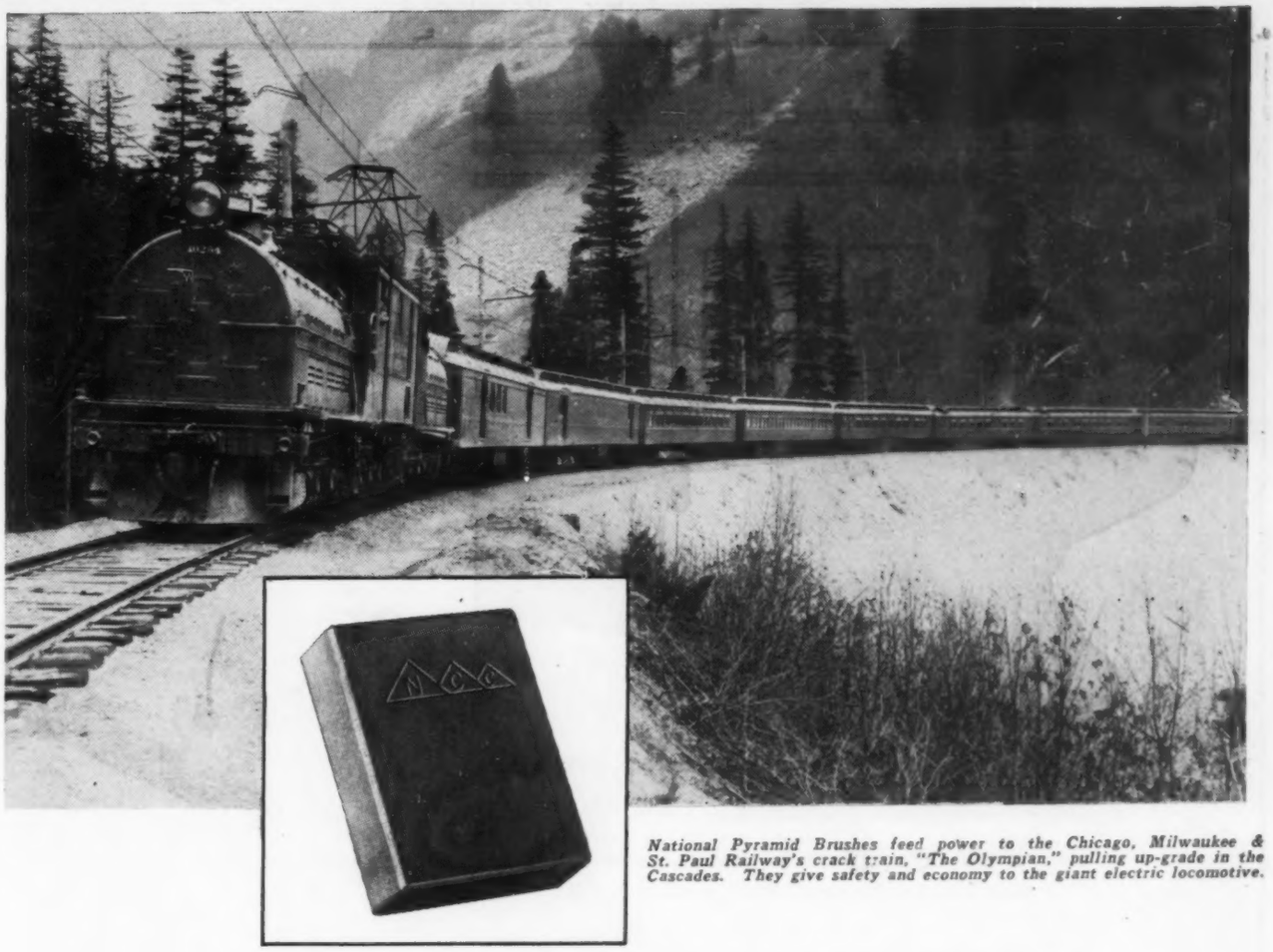


SQUARE D COMPANY, DETROIT, U. S. A.
FACTORIES AT: DETROIT, MICH., PERU, IND., WALKERVILLE, ONT.

BRANCH OFFICES: Boston, Buffalo, Chicago, New York
Pittsburgh, St. Louis, Toronto, Philadelphia, Cincinnati, Milwaukee
Montreal, Atlanta, Cleveland, San Francisco, Winnipeg, Vancouver

(36)

Electrify! **SQUARE D**
Safety Switch



National Pyramid Brushes feed power to the Chicago, Milwaukee & St. Paul Railway's crack train, "The Olympian," pulling up-grade in the Cascades. They give safety and economy to the giant electric locomotive.

Worthy of the Olympian Itself

GREAT powerful motors pull the famous Olympian, the train de luxe of the Chicago, Milwaukee & St. Paul Railway, steadily up-grade until the heights of the Great Divide have been topped. National Pyramid Brushes feed these giants with power—smoothly, economically, unfailingly.

In their majestic, electrically braked descent on the other side, these same locomotives generate power and return to the line through their National Pyramid Brushes a goodly proportion of the electrical energy they have previously consumed.

Here in the Cascades the Olympian demands not only economy, but safety for the precious lives entrusted to its care. The double duty of the Olympian's locomotive makes doubly significant the use of National Pyramid Brushes in it. Factory and central station power plants use National Pyramid Brushes for freedom from costly interruptions in service.

You may have applied to your own installations the same brush engineering skill upon which the Chicago, Milwaukee & St. Paul depends.

NATIONAL CARBON COMPANY, INC.

Cleveland, Ohio San Francisco, Cal.

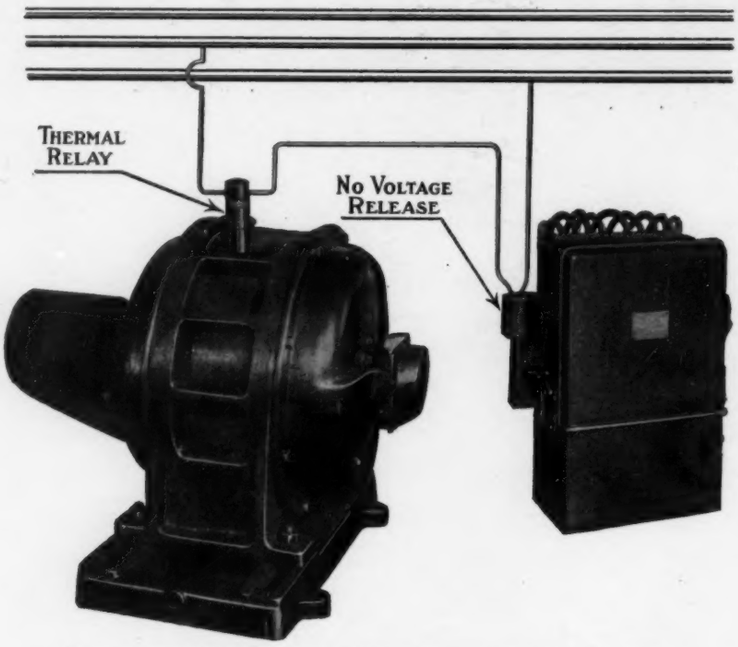
CANADIAN NATIONAL CARBON CO., Limited. *Factory and Offices:* Toronto, Ontario

Emergency Service Plants

CHICAGO, ILL.
560 West Congress St.
Phone: HARrison 0143

PITTSBURGH, PA.
7th Floor, Arrott Power Bldg. No. 3
Barker Place
Phone: SMIthfield 0740-0741

NEW YORK, N. Y.
237 East 41st St.
Phone: VANderbilt 0425-0426



Motor Protection Based on Motor Temperature Is Correct

How to Reduce Rewinding of Motors

YOU do not want to shut a motor down, even though it is running single phase or overloaded, until it is absolutely necessary to do so.

A TIME comes, however, when the motor must either be shut down or allowed to roast out.

MOST motors have to be rewound because they have roasted out.

ROASTING out of a motor may be due to "single-phasing," overload, rotor dragging on stator, or other causes.

WHATEVER the cause, the motor overheats.

IT is this overheating that does the damage and dictates when the motor must be shut down to avoid a breakdown.

That is why you should install a simple, effective, reliable, and inexpensive type "TR" Thermal Relay on each of your motors.

THE AUTOMATIC RECLOSING CIRCUIT BREAKER CO.

COLUMBUS, OHIO

PITTSBURGH: 223 Oliver Bldg.
ST. LOUIS: 401 National Bank of Commerce Bldg.
WILKES-BARRE, PA.: 816 Miners Bank Bldg.
CHARLESTON, W. VA.: 317-318 Moore Bldg.

BENJAMIN

Makers of Things More Useful

An Installation of Benjamin Elliptical Angle Reflectors

Benjamin Elliptical Angle Reflector Socket

For use where overhead conditions make lighting from the side desirable.

For wide bays to supplement overhead lighting with intense lighting from the side.

They light up not only wide areas in a horizontal plane, but throw a flood of light on vertical surfaces as well.

Especially useful, indoors or out, where service conditions require a heavy duty unit.

The Crysteel Porcelain Enamel is easily cleaned and makes the reflector highly resistant to moisture, smoke, gases and the dust and dirt of heavy industrial processes.

Equipped with heavy type X weatherproof fitting and two-piece porcelain, easy-to-wire keyless socket. Benjamin lamp grip prevents loosening and falling of lamp under vibration.

Where there is the possibility of unauthorized removal or theft of lamps, they may be fitted with Self-Locking Socket.

Our nearest office will gladly give further information
Send for new Bulletin on Industrial Lighting

BENJAMIN ELECTRIC MFG. CO.
847 W. Jackson Blvd., Chicago
247 W. 17th Street, New York
580 Howard Street, San Francisco
Pittsburgh District: P. O. Box 807; Phone Court 2032

"For every requirement in Industrial Illumination"

"...these fuses are better from every standpoint than any fuse we have ever used..."

That's what a Prominent Automotive Manufacturer writes of BUSS Renewable Fuse ~

Gentlemen:-

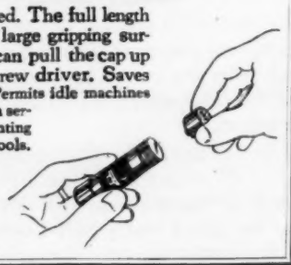
In reply to your question as to how we like the Buss Fuses for which we have given you a contract, we wish to state that after a period of about six months our electrician reports that these Fuses are better from every standpoint than any fuse we have ever used.

We find changes are made very much quicker and the life of the fuse is slightly longer than any other we have used. We have had several samples of Fuses of other makes and after careful experiment have found the Buss Fuses will give better service in every way.

From a letter in our office files. Manufacturer's name withheld by request.

Hands are all you need to renew this fuse

—no tools required. The full length cap gives such a large gripping surface that anyone can pull the cap up tight without a screw driver. Saves time in renewing. Permits idle machines to be gotten back in service quickly. No hunting or running back for tools. Assures quick renewal in an emergency. Buss fuses take the annoyance out of fusing.



Examine the fuse for yourself—this coupon will bring it to you.

BUSSMANN MFG. CO., St. Louis, Mo.

BUSS FUSES

APPROVED IN ALL TYPES AND SIZES

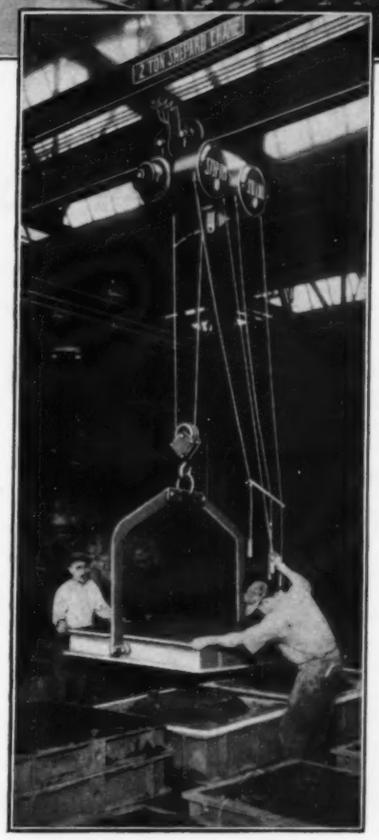
TRADE Buss Fuses ELECTRICITY'S SAFETY VALVE MARK REG U.S PAT OFF

"ELECTRICITY'S SAFETY VALVE" MEANS ON

BUSSMANN MANUFACTURING CO. A.I.S. 1-24
3819 North Twenty-Third Street, St. Louis, Mo.
Without obligation, send me for examination sample 30 ampere, 250 volt Ferrule Contact Type BUSS Renewable Fuse.

Name / Company / Position / Street / City / State

Shepard cage control electric hoist and electro-magnet on Shepard Transfer Crane, unloading pig iron.



A Shepard Floor Control electric hoist on Shepard Single I-Beam Crane in the foundry, where its precision of control is a valuable feature.

Indoors or out for every lifting service

Receiving raw materials; doing the lifting and transfer work connected with manufacturing operations; carrying finished products to shipping platform—all load-moving operations necessary in producing practically every commodity, are handled in a highly efficient way by Shepard equipment.

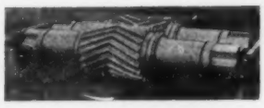
Steadily and consistently Shepard equipment does its work. Indoors or out, it is immune to dirt, dust, dampness and fumes, for all vital parts are enclosed within tight metal housings. Write for literature. Learn about Shepard Electric Cranes and Hoists, with their Balanced Drive, oil bath lubrication, permanent alignment, safety features, and other points of design and construction that provide what you most desire—SERVICE.

SHEPARD ELECTRIC CRANE & HOIST CO.
382 Schuyler Ave., Montour Falls, N. Y.
Branches in Principal Cities
Member Electric Hoist Mfrs. Ass'n.

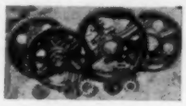
Accurately placing pieces for machining operation. One man is "his own gang" when using a Lift About.

REG. U.S. PAT. OFF.

SHEPARD
ELECTRIC CRANES & HOISTS

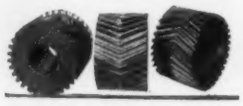


Herringbone Mill Pinions



Motor and Crane Gears

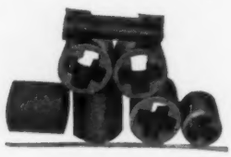
Mill Table Gears



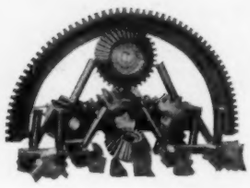
Herringbone Gears

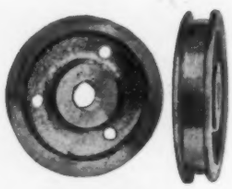
Cincinnati "Tool Steel" gears outlast 8 to 10 Untreated and are much stronger

Tool Steel Face
as hard here as on the very surface (This is one of the great differences between tool steel and case-hardening methods)
Toughened Center



Coupling Boxes and Spindles



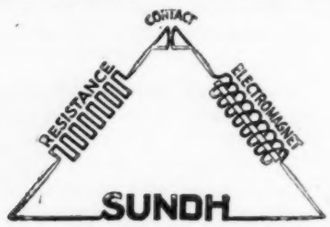


Crane Wheels

The Tool Steel Gear and Pinion Company

CINCINNATI, OHIO

The Elements of our Business

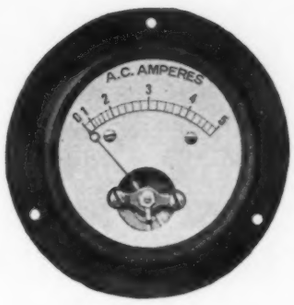


	Bulletin
Alarm, High and Low Liquid Level	3610-3615
Automatic Fire Pump Panels, Combined Hand and (See Panels, Fire Pump).	
Automatic Starters (See Starters, Automatic).	
Automatic Transfer Switches	5600
Brakes, Magnetic	9920
Circuit Breakers	3800-3815
Contactors (See Switches, Magnet).	
Control, Machine Tool	9000
Controllers, Elevator	9999
Elevator Controllers	9999
Fire Pump Panels (See Panels, Fire Pump).	
Float Switches	3600-3625
Hand and Automatic Fire Pump Panels, Combined. (See Panels, Fire Pump).	
Hand Operated Switches	3600
Hand Starters (See Starters, Hand).	
High and Low Liquid Level Alarm Switches	3610-3615
Indicator, Level, Liquid, Remote	3625
Level, High and Low Liquid, Alarm Switch	3610-3615
Level, Indicator, Remote	3625
Lighting Panels, Remote Control	7100
Low Levels, High and, Alarm Switches	3610-3615
Machine Tool Control	9000
Magnetic Brakes (See Brakes, Magnetic).	
Magnet Operated Valves	5700
Magnet Switches, A. C.	7600
Magnet Switches, D. C.	7500
Magnets	6500
Manual Fire Pump Panels (See Panels, Fire Pump).	
Manual Starters (See Starters, Hand).	
Panels, Fire Pump	8800-8830
Panels, Lighting, Remote Control	7100
Panels, Pressure Regulator (See Pressure Regulator, also Panels, Special.	
Panels, Special	5400-5423
Pressure Regulator, Gauge Type	4900-4902
Pressure Regulator Panels (See Panels, Special).	
Regulator, Pressure (See Pressure Regulator).	
Regulators, Speed (See Speed Regulators).	
Relay, Tumbler	7250
Remote Controlled Lighting Panels	7100
Remote Controlled Speed Regulators (See Speed Regulators).	
Remote Liquid Level Indicator	3625
Remote Switches (See Switches, Remote, also Switches, Magnet).	
Self Starters (See Starters, Automatic).	
Solenoids (See Magnets).	
Solenoid Operated Valves	5700
Special Panels (See Panels, Special).	
Speed Regulators, D. C.	8500-8520
Starters, Automatic, A. C.	5800-6200
Starters, Automatic, D. C.	5300-5350
Starters, Hand	8320
Starters, Hand, D. C.	8200
Starters, Manual (See Starters, Hand).	
Sump Switches (See Switches, Float).	
Switches, Float	3600-3625
Switches, Hand Operated	3600
Switches, High and Low Liquid Level Alarm	3610-3615
Switches, Magnet, A. C.	7600
Switches, Magnet, D. C.	7500
Switches, Remote (See also Switches, Magnet)	7200-7250
Switches, Sump (See Switches, Float).	
Switches, Tank (See Switches Float).	
Switches, Time	6900
Switches, Transfer, Automatic	5600
Tank Switches (See Switches, Float).	
Terms	360
Time Switches	6900
Transfer Switches, Automatic	5600
Tumbler Relay	7250
Valve Control	5700
Valve, Magnet Operated	5700
Valve, Remote Controlled	5700

WRITE FOR CATALOG

SUNDH ELECTRIC COMPANY, NEWARK, N. J.

Satisfaction is Not Always Dependent on a Large Expenditure



Type TIA

Type FIA

ROLLER-SMITH Type TIA (3½″) and Type FIA (4″) A.C., ammeters, voltmeters and wattmeters are low in price, but they are well made little instruments, accurate, well damped, and, **above all,** reliable. Ranges up to 50 amperes, 2500 volts and 7.5 K.W.

Send for Bulletin No. AK-420.
It Shows The Complete Line.

ROLLER-SMITH COMPANY
Electrical Instruments Meters and Circuit Breakers

MAIN OFFICE
2131 Woolworth Bldg., New York

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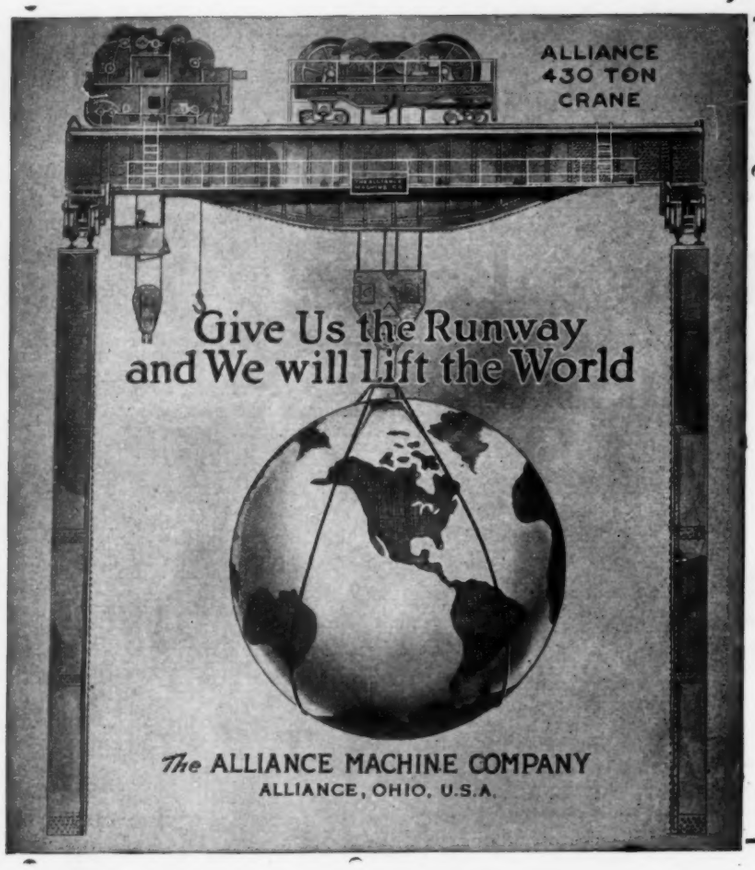
Offices in Principal Cities in U. S. and Canada



ALLIANCE CRANES

Largest Builders of the World's Largest Cranes

204 of 100 Tons Capacity and Over

STANDARD CRANES

55	100 tons
2	115 tons
42	125 tons
24	150 tons
22	175 tons
2	200 tons
1	225 tons
1	250 tons
3	430 tons

STRIPPING CRANES

8	100 tons
1	125 tons
19	150 tons
13	200 tons
1	Single Ram, 320 tons

COMBINATION CHARGERS AND STRIPPERS

3	100 tons
3	150 tons
4	200 tons

LUMBA

A common practice among Hindu pilgrims in making the circuit of sacred places is to do so by a series of prostrations or lumbas.

Taking a stone in hand they prostrate themselves, placing the stone as far ahead as possible, and keep on prostrating and prostrating until they have made a complete circuit.

Sometimes the distance covered in making the circle is several miles—so the effort expended is ultraconsiderable on a warm day.

And when it's all over—where have they landed?

Right at the spot where they started.

"Then why do they do it?" you ask.

—To which we reply: "It is the custom," just as it is the custom for operators who use cheap carbon brushes to true up their commutators regularly, lubricate them and do all sorts of stunts that don't get 'em anywhere. Of course they wouldn't have to do it if they used prescribed Morganite brushes on the machines, but as yet they ALL haven't learned. The time, however, is coming—

MORGANITE BRUSH CO., INC.
519 West 38th St., New York City

DISTRICT ENGINEERS AND AGENTS

Electric Power Equipment Corp., 412-420 North 18th St., Philadelphia, Pa.

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Electrical Engineering & Mfg. Co., 909 Penn Ave., Pittsburgh, Pa.

Electrical Engineering & Mfg. Co., 422 Union Bldg., Cleveland, Ohio.

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Special Service Sales Co., 202 Russ Bldg., San Francisco, Calif.

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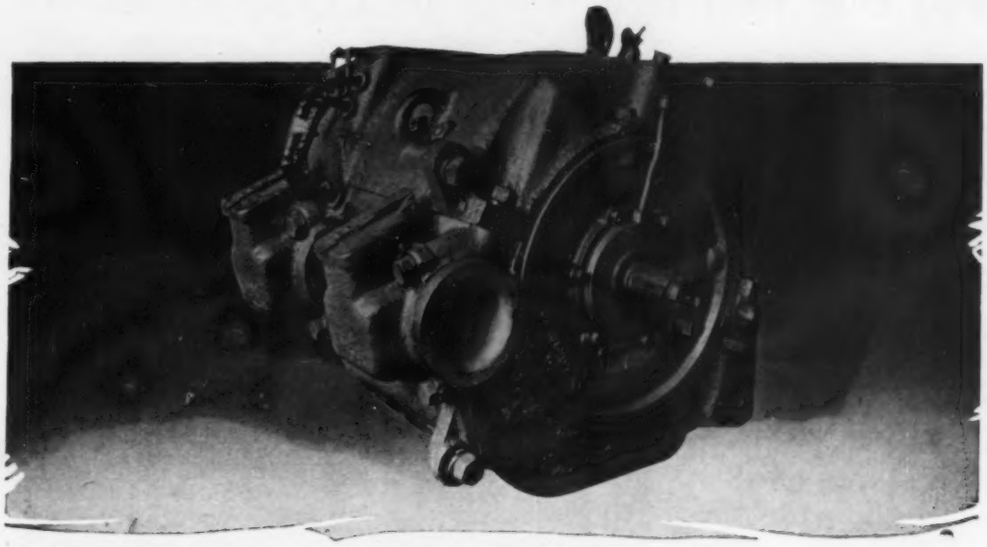
Electrical Engineering & Mfg. Co., 607 Mercantile Library Bldg., Cincinnati, Ohio.

Railway & Power Engineering Corp., Ltd., 131 Eastern Ave., Toronto, Ontario, Canada.

Morganite

SKF



Minimum Attention Required
By Ball-Bearing Equipped Electric Motors

WITH Skayef self-aligning ball bearings on the rotors of rotating electrical machinery maintenance and repairs are reduced to a minimum.

Ball-bearing housings can be more satisfactorily arranged for the retention of the lubricant and the exclusion of foreign matter than can plain-bearing housings. As a result commutator troubles and short circuits due to leaking lubricant are avoided and fewer applications of lubricant are required.

Furthermore self-aligning ball bearings require no adjustments, as they will not bind, heat or develop appreciable wear in service when properly housed. Thus the electrical elements of a ball-bearing equipped motor are protected against short-circuits and other damage due to dropped armatures.

Because of their demonstrated superiority of performance and maintained precision, **SKF** marked ball bearings are in extensive use throughout the world on rotating electrical machinery of all kinds. May our engineers co-operate in bringing the advantages of ball bearings to your machines?

THE SKAYEF BALL BEARING COMPANY

Supervised by **SKF** INDUSTRIES, INC., 165 Broadway, New York City

1069

Normal View *Deflected View*

BALL BEARINGS
The Highest Expression of the Bearing Principle

LAPP HIGH VOLTAGE PORCELAIN

Did you ever hear of a failure of a Lapp Insulator?

Seven years of production—including highest voltage pin and suspension types —without a failure!

There is the reason for use of Lapp Insulators, besides which—for "trimmings" —they provide unexcelled mechanical strength.

Lapp vacuum process of porcelain production, surfaces of porcelain glazed all over, Lapp over potential test methods.

LAPP INSULATOR CO., Inc., LeRoy, N. Y.

S. H. LANYON
509 New Call Bldg., San Francisco

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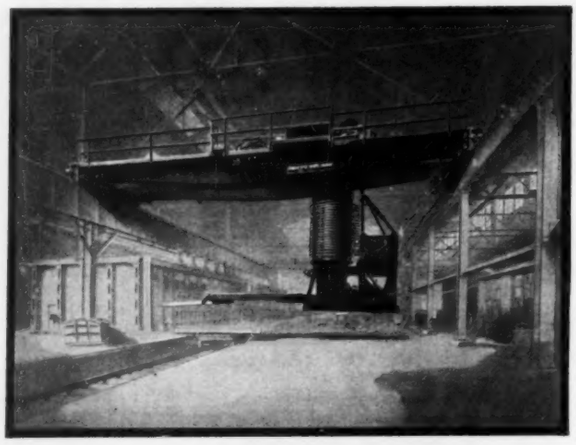

Morgan 5-Ton, 45'-0" Span Overhead Revolving Type Billet Charger

The World's Standard

Morgan Equipment has won the title, "The World's Standard," because it measures up so fully to the heavy, exacting demands of the steel industry.

Morgan Equipment has been so closely allied with the steel industry for so many years that it just naturally seems to be a part of it.

You'll find Morgan Equipment profitably busy in most every steel plant.

The Morgan Engineering Company

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122 So. Michigan Ave.

NEW YORK
120 Broadway

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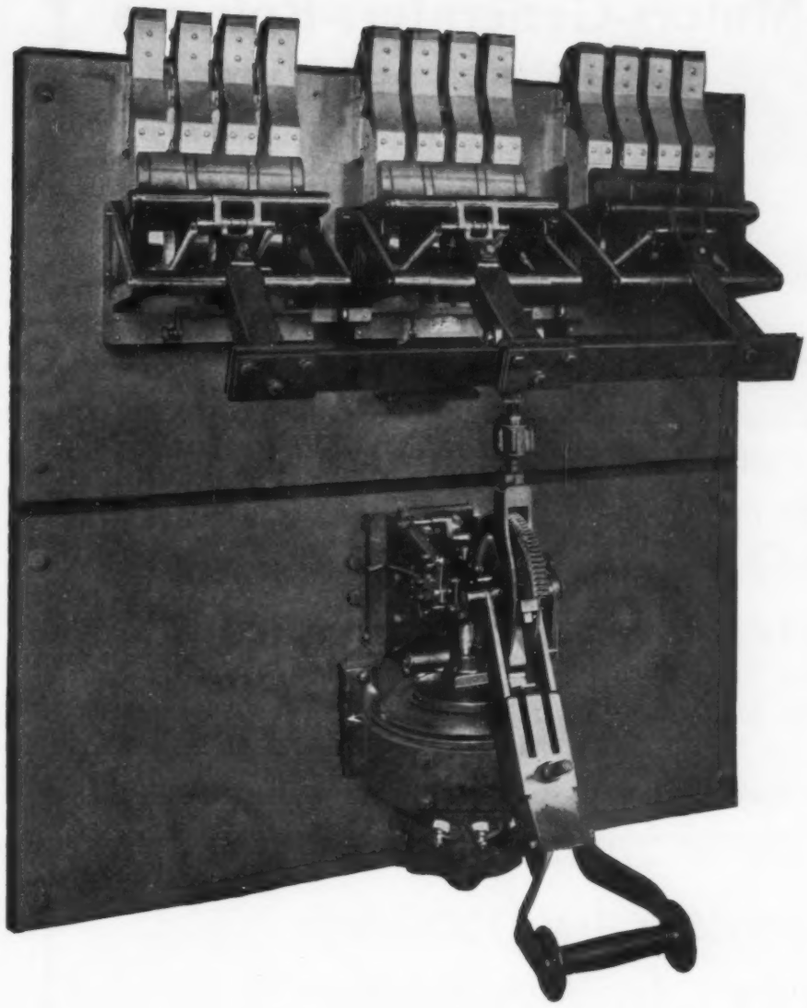
1420 Oliver Bldg.

ALLIANCE, OHIO

Designers, Manufacturers and Contractors

Electric Traveling Cranes, Rolling Mill Machinery, Ordnance Steel, Shipbuilding and Forging Plants Complete, Rock Crushers, Special Machinery for Any Purpose

Locomotive Repairing and Rebuilding



Air or Oil?

I. T. E. AIR BREAK

at 550 volts alternating current

has definite advantages not present in the oil breaker.

There is no oil to explode or leak away.

The working parts are at all times visible, making inspection not a matter of time and money.

Its upkeep is negligible.

Has series overload coils, direct action, no relays.

For large capacities we recommend motor rather than solenoid actuation.

The I-T-E CUTTER COMPANY
ESTABLISHED 1888 PHILADELPHIA
1826 HAMILTON STREET

Dinkey Controllers-Motors-Generators-Rotaries
All Give Better Service When Equipped With

USG

BRUSHES

CARBON - GRAPHITE - METAL

A Grade for Every Service

Catalog B-3 gives the details. Write for it.

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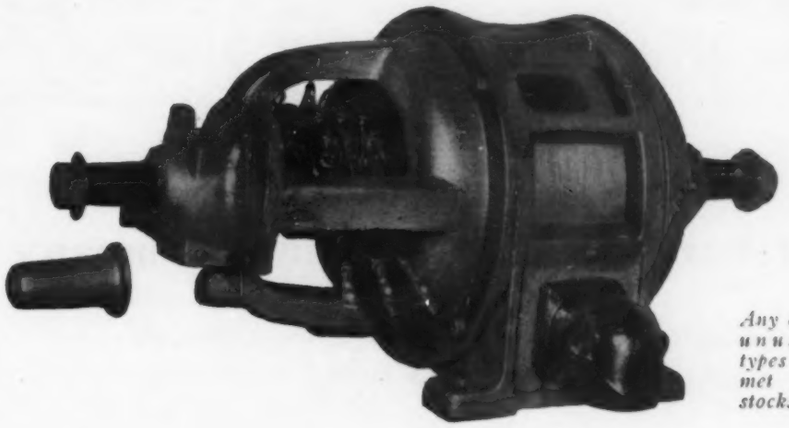
There is a

HOLOPHANE LIGHTING UNIT

for Your Every Need

The Unit illustrated is especially recommended for industrial plants

RUMSEY
ELECTRIC COMPANY
Electric Supplies and Machinery
Everything in Radio
1007 Arch St.
Philadelphia, Pa.



Any call for standard or unusual applications, types and ratings can be met from our House stocks of motors.

Which do you look for?

In the motors you specify, which of these features most directly governs your choice?

—quality of motor
—accessibility of service
—speed of delivery
—fairness of price

Standardize on Western Electric motors and control, and it is not a question of "Which?", but a certainty of all these requirements.

The how and why of this is a story we should like the privilege of telling you in person. Just say the word to our nearest House.

Western Electric Company

OFFICES IN 47 PRINCIPAL CITIES

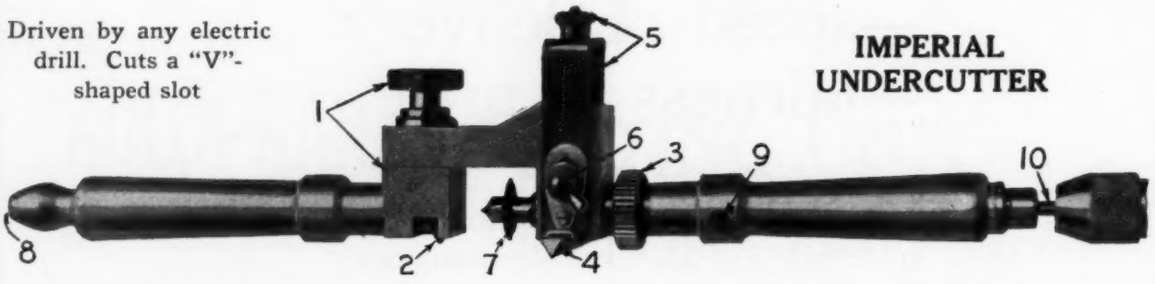
Pittsburgh Transformer Company

Largest Manufacturers of Transformers Exclusively in the United States

Pittsburgh, Pennsylvania

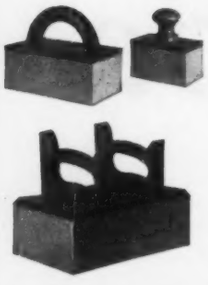
Driven by any electric drill. Cuts a "V"-shaped slot

IMPERIAL UNDERCUTTER



Goodnite Cleaning Tool
For Cleaning Commutator Slots

Commutator Slotting Files
For Undercutting Mica



IMPERIAL COMMUTATOR STONES
eliminate
Flat-spots
Ridges
High mica
High bars
and other defects quicker, better and cheaper than turning.

THE MARTINDALE ELECTRIC CO.,
11729 Detroit Ave., Cleveland, Ohio.
Gentlemen: Please send me information on your Products.
Name and Title.....
(Please Print)
Company.....
Street.....
City and State.....

During 1923

One of the interesting features of the development of the Pittsburgh District as a great power center during 1923 was the number of important industrial installations on the lines of the Duquesne Light Company.

Some of the more prominent of these included Pittsburgh Steel Co., Glassport Hoop Mill, 2,000 horsepower; National Tube Company, Republic Works, 1,200 horsepower; Firth-Sterling Steel Company, Bar Mill, 750 horsepower; Crucible Steel Company of America, Park Works, second electric furnace, 2,000 kilowatt; Flannery Bolt Company, Bridgeville Plant, 600 horsepower; Westinghouse Electric & Mfg. Company, Copper Mill, 500 horsepower; Pittsburgh Seamless Tube Company, Murado Tube Mill, 5,000 horsepower; Dilworth Porter Company, Spike Mill, 1,000 horsepower; Standard Seamless Tube Company, Economy Plant (addition), 2,000 horsepower.

The decision of these large industrial establishments to replace their equipment with electric drive should be sufficient to warrant you in having an investigation made to determine how economies may be effected in your properties.

This service may be had without obligation to you. Call Grant 4300 and ask for our Power Engineer.

DUQUESNE LIGHT COMPANY.

"UNION" RENEWABLE FUSES

Their Long Life is the Result of Strength in Every Part

UNION
TRADE MARK REG. U.S. PAT. OFF.

The ability of "Union" Renewable Fuses to withstand more blowouts than any other fuse is due to the studied design which gives exceptional strength to *every part*. There isn't a single flimsy or carelessly made unit in the entire fuse. Hence, when assembled and put to the test of actual service, a "Union" Renewable Fuse doesn't develop those weak spots which cause ordinary fuses to go to pieces after a few blowouts.

If a substantial saving in fuse maintenance interests you, examine the following features of "Union" Renewable Fuses.

1. Both Knife Blades are in perfect alignment. This prevents overheating of terminals, preventing possible destruction of fuse. The Yoke is swedged to the Knife Blade, forming a rigid baffle plate.
2. The Washers are a heavy, die-cut piece, accurately slotted so they can be easily lifted off with the fingers.
3. Cap is heavy in construction, like all other parts, and carefully machined.
4. The Ferrule, which forms one piece with the cap, is screwed to the *outside* of the tube and permanently fastened in the right position by a rivet, insuring permanent alignment of the blades.
5. The Tube is made of special extra heavy, fire-resisting fibre of unusual strength.

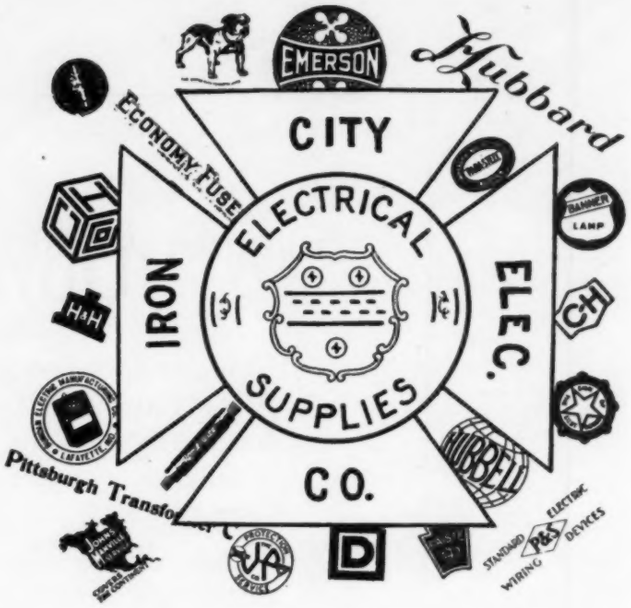
At every point Strength, Ruggedness, Accuracy. No wonder that

The "Union" Saves More Than ANY Other Renewable Fuse

CHICAGO FUSE MFG. CO.

Manufacturers also of Switch and Outlet Boxes, Cut-Out Bases, Fuse Plugs and Fuse Wire.

CHICAGO **NEW YORK**



The Trade Mark

of the

Iron City Electric Co.

436-38 Seventh Avenue

Pittsburgh, Pa.

REPRESENTING

"The House That Service Built"

IS BACKED BY A GROUP OF

TRADE MARKS

of Well Known Manufacturers Guaranteeing the Quality of the Goods You Receive

Our Representative will be glad to discuss
Fynn-Weichsel Motors for your plant.

Transformers:
Power and Distribution.

Motors:
Polyphase and Single Phase,
Induction, Split Phase, and
Repulsion Induction
Fynn Weichsel,
Synchronous Induction.

LUDWIG HOMMEL & CO.

530 Fernando St.
PITTSBURGH, PA.

Rose Building
CLEVELAND, O.

Pittsburgh
District Managers:
Wagner Elec.
Corporation
Sales Representatives
Sangamo Elec. Co.

1891 — 1924

MORGAN
Construction Company

Worcester, Mass., U.S.A.

Designers and Builders of

Morgan Continuous Mills

for

Billets, Sheet Bars, Skelp, Merchant-Bars, Hot-Strip, Rods

also

Wire Drawing Machines
Producer Gas Machines
Straightening Machines
Isley Reversing Valves
Re-Heating Furnaces
Reducing Gear Units
Shears

Our Engineering Department

is prepared to solve successfully your problems in design or arrangement of plant and equipment from open hearth to finished product

1891 — 1924

Electrical Engineering and Manufacturing Company

General Offices:
PITTSBURGH, PA.

We are prepared to furnish your requirements in the following materials and equipment:

"MORGANITE" Carbon-Graphite Metal Brushes.

"ROWAN" Automatic Controllers and Starters.

"SUMET" Bronze and Babbitt Bearing Metals.

"DUTCHESS", Empire or Varnished Cloth and Tape.

ELECTRICAL INSULATING Varnishes and Compounds.

"BELL" Cedar Poles.

CROSSARMS; Douglas Fir and Pine.

LINE MATERIALS; Hangers, Brackets, etc.

TRACK GRINDERS; Reciprocating and Rotating.

"AJAX" Welding and Bonding Machines.

MINE HOISTS and Winches, Car Pullers, etc.

HIGH and **LOW** Tension Insulators.

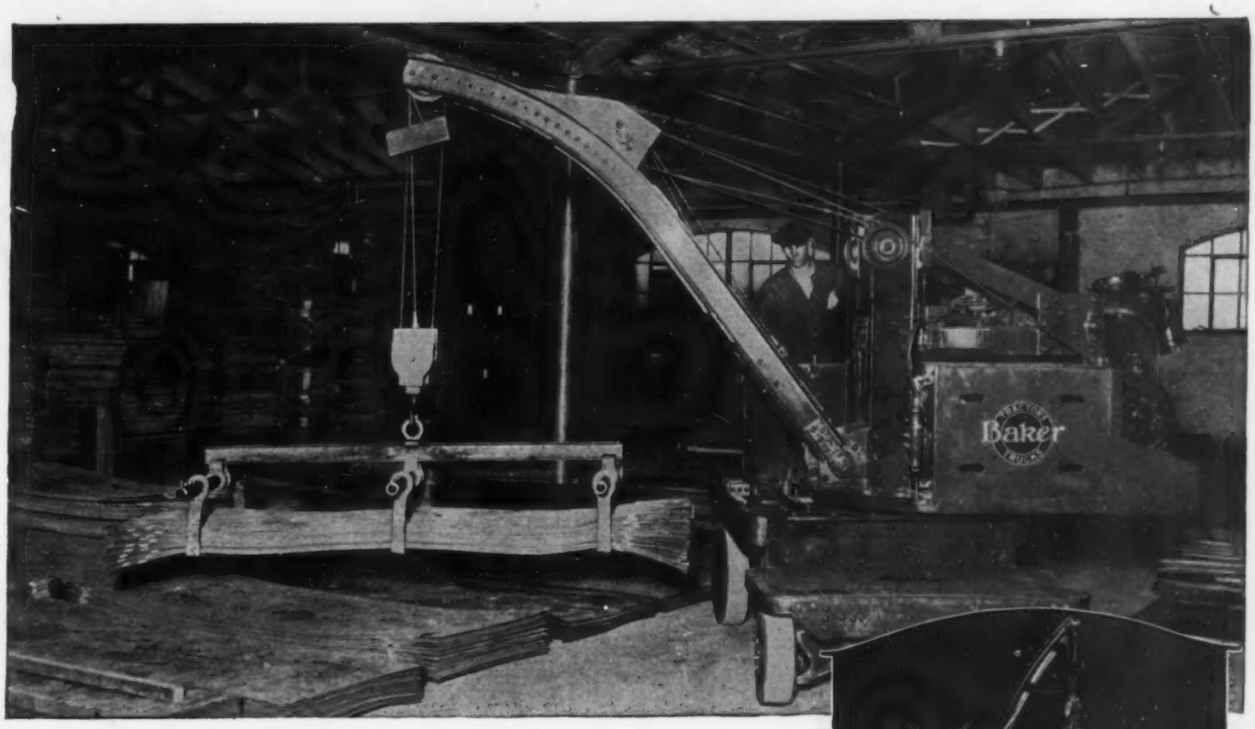
"ELPECO" High and Low Tension Switching Equipment, Bus Fittings, etc.

We have a corps of expert engineers, specialists in the above lines, who will be glad to give immediate attention to your inquiries or to see you at your request for consultation regarding applications or equipment. Call or write our nearest office.

CINCINNATI, OHIO
607 Mercantile Lib. Bldg.
Phone Maine 3257

CLEVELAND, OHIO
320 Union Bldg.
Phone Prospect 1252

PITTSBURGH, PA.
907-909 Penn Ave.
Phone Grant 6693-4
P. & A. Main 244



A New Baker Locomotive-Type Crane

COMPACT enough to carry its load right into a box car, long enough in reach for most erecting work and so mobile that it eliminates the need for spotting the job under a stationary crane or overhead craneway, this latest type of Baker material-handling equipment combines the major advantages of both truck and crane.

With it you can load and unload railroad cars, place large castings on machine beds, stack and carry pipe or brass stock, pig iron or scrap, and do numberless other heavy tasks.

It is equipped with standardized Baker parts throughout, has three separate motors, limit switches for all motions and is controlled by three handles conveniently located on the dash.

The standard boom is 12 feet in length, but booms from 10 to 19 feet long can be supplied on specification. Write for completely explanatory catalog of all models of Baker material-handling tractors and trucks.

Baker Industrial Division

THE BAKER R & L COMPANY · CLEVELAND, OHIO

In The Erecting Shop

EQUIPPED with the 19 ft. boom, the Baker Locomotive Type Crane is especially valuable in assembling, erecting or dismantling large machinery.

An auxiliary boom attached to the base makes it possible to reach parts that are not otherwise accessible to the main boom.

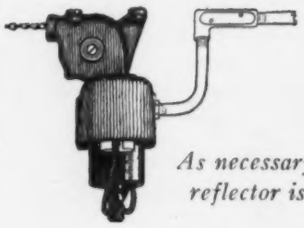
The three-way crane, however, is only one of several Baker electric material-handling tractors and trucks that greatly simplify heavy work.

Backed by data gained in scores of varied and successful installations, and without obligation on your part, a Baker engineer will gladly investigate your problems and recommend the most efficient type for your needs.

THE BAKER R & L COMPANY
Cleveland, Ohio

ELECTRIC TRACTORS AND TRUCKS
TRADE-MARK REG. U.S. PAT. OFF.
Baker

THOMPSON LAMP MAINTENANCE HANGERS



As necessary to the reflector as the reflector is necessary to the bulb.

No Climbing Hazards
No Electrical Hazards

—making reflectors accessible for frequent cleaning is the most logical means of saving light and promoting production —easily included in present lighting systems—enabling lights to be hung high for the best distribution.

Send for Catalog B-21

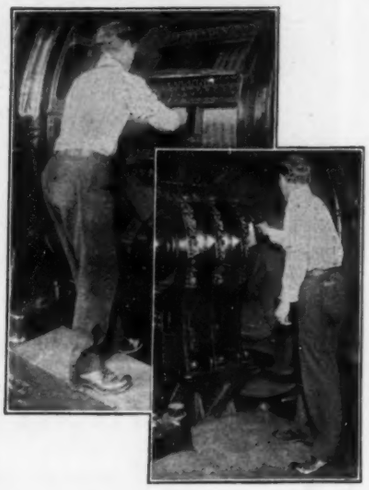
The Thompson Electric Co.
226 St. Clair Avenue, N. E.
Cleveland Ohio, U. S. A.

Will you let us

demonstrate a method of saving hundreds of dollars and getting better service from your generators or motors

?

at our expense



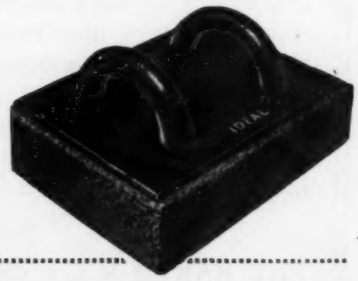
The greatest efficiency of operation comes through perfect commutation.

The regular use of the Ideal Commutator Resurfacer for a few moments at a time eliminates the greatest cause of trouble, sparking, high mica, and grooves or flat spots in the commutator. You are assured of continuous operation and saved the expense of extensive repairs.

Have you used the Ideal? If so you do not need this advertisement. If you haven't, and wish to use it at our expense, first, simply send in the coupon below for our generous free trial offer.

Ideal Commutator Dresser Co.
5315 North Western Ave., Chicago, Ill.

free trial offer



Ideal Commutator Dresser Co.,
5315 N. Western Ave., Chicago.

Gentlemen: Please send me an Ideal Commutator Resurfacer for free trial. If I like it I'll pay or it. If I don't like it I will return it. The trial will have cost me nothing. I want to use it on equipment as follows:

Approx. R.P.M.....

Diameter of Commutator or Ring.....

Approx. Width of Commutator or Ring Surface.....

Approx. Distance Between Brush Sets.....Condition.....

Collector Ring or Commutator Material.....

Name..... Position.....

Company..... Company Address.....

City..... State.....

A.I.S.E.E. 1-24

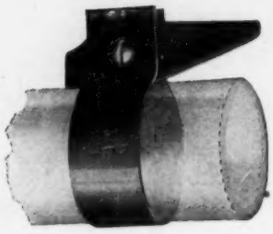
CORLISS BRUSHES

The increasing importance of electricity in the Iron and Steel industry is directly reflected by the increase in size of the Association Journal. Manufacturers of even the most supplementary equipment can claim some credit for this progress.

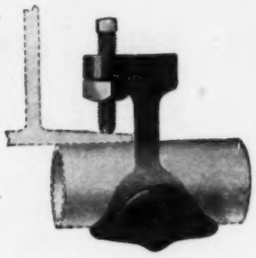
The exceptional characteristics of Corliss brushes, such as their unusually long life, are responsible for Corliss grades being used to improve the service of every type of mill application.

CORLISS CARBON CO.
Bradford, Penna.

No. 350 Type C Conduit Hanger—right angle position.



Type A Conduit Hanger.



Type C Conduit Hanger—parallel position.

Type D Conduit Hanger.

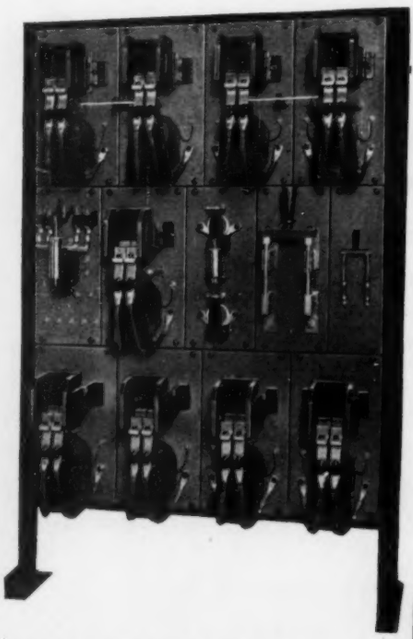
WAYMAN Conduit Hangers

Recommended for the most severe service, permanent or temporary, and guaranteed against breakage in application and in service.

The Hanger that provides a means of instantly attaching cables and conduits for electrical, steam, air, gas and water lines to structural steel without the necessity of drilling holes or using wood blocks.

Write for the Wayman Catalogue No. 3 illustrating the complete line of electrical fittings.

The Wayman Electric & Mfg. Company
East Palestine, Ohio



150 H.P. Type 4750 Full Speed Reversing Mill Controller

Automatic Motor Starters and Controllers

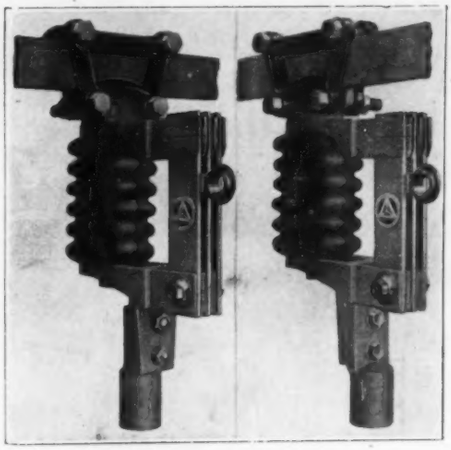
FOR

Alternating and Direct Current Electric Motors

May we send our nearest representative to see you?

ROWAN CONTROL
THE ROWAN CONTROLLER CO., BALTIMORE, MD.

The REAL STANDARD



Bus Type Disconnecting Switches

"UNIT-TYPE," the trade name adopted by DELTA-STAR for its high tension switching and protective equipment, has long been associated with superior service by electrical men.

Suppose that at some unexpected time it became necessary to very quickly increase the operating voltage of some branch of the system. With Unit-Type equipment in use, the bus supports and fittings of the stations affected could be easily reconstructed for the higher voltage—right on the spot. Additional standardized insulators could be quickly fitted into place and the job finished up in short order.

You Better Buy, The Better Buy

"UNIT-TYPE"

The REAL STANDARD

Why not send for our catalog?

Delta-Star Electric Co

346 Union Arcade, Pittsburgh
1333 Real Estate Trust Bldg., Philadelphia
2433-61 Fulton St., Chicago

Flexible and Durable

These are the first requirements of flexible couplings for direct connected machinery—the most efficient and trouble-proof drive. These requirements and many other desirable features are obtained in each of the five Francke types, all described in our new bulletin.

A suitable Francke is now ready for any drive from ¼ H.P. to 5,000 H. P. and for any speed or service conditions.

Just as important as correct design and satisfactory workmanship is the matter of reasonable operating conditions. This new bulletin describes the service for which each type is intended, tells how to lubricate, etc. *Send for Bulletin No. 37.*

SMITH & SERRELL

Coupling Specialists Since 1912.

47 Central Avenue, Newark, N. J.

District Office, Fulton Building, Pittsburgh

APPLETON ELECTRIC PRODUCTS
Reg. U.S. Pat. Off.

"UNILETS"
REG. U.S. PAT. OFF.

Ask For "Unilets"

Just say "Unilets" if you want the best in electrical fittings. And when you ask for "Unilets" be sure you get "Unilets." "Unilets" are manufactured by the Appleton Electric Company alone but their use is universal.

In Catalogue Nine, a copy of which will be sent upon request, you will find, listed and illustrated, a "Unilet" to meet every one of your wiring requirements. A pictorial index saves time and error in planning installations and assures the correct treatment of every wiring problem.

APPLETON ELECTRIC COMPANY
1717 Wellington Avenue,
Chicago

Write for Catalog 9-T.

APPLETON

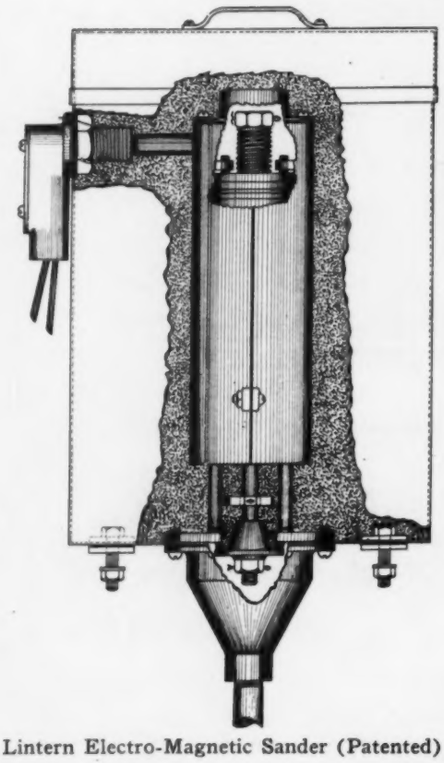
"IT TAKES SAND TO WIN"

Do you allow your men to put sand on the overhead crane runways by hand?

ANOTHER MAN HAS RECENTLY BEEN KILLED WHILE APPLYING SAND IN THIS MANNER. WHY KILL ANY MORE MEN?

Do not subject your men to these dangers when the operator can apply sand to the rails by merely stepping on a switch located in the operator's cage.

Sand is the only cure for slippery rails and when applied with **Lintern Electro-Magnetic** Sanders it is placed on the rail in the **right amount**, in the **right place** and at the **right time.**



Lintern Electro-Magnetic Sander (Patented)

Many of the very serious and often fatal accidents of which the overhead crane is guilty can be avoided by the use of

SAND.

For more than three years hundreds of cranes in steel mills and other large industrial plants have been free from all hazards and delays due to poor traction. They are equipped with LINTERN ELECTRO - MAGNETIC SANDERS.

Save Your Men
Save Your Cranes
Save Your Runways

HOPPER

The Nichols-Lintern Company

7960 Lorain Ave., CLEVELAND, O.

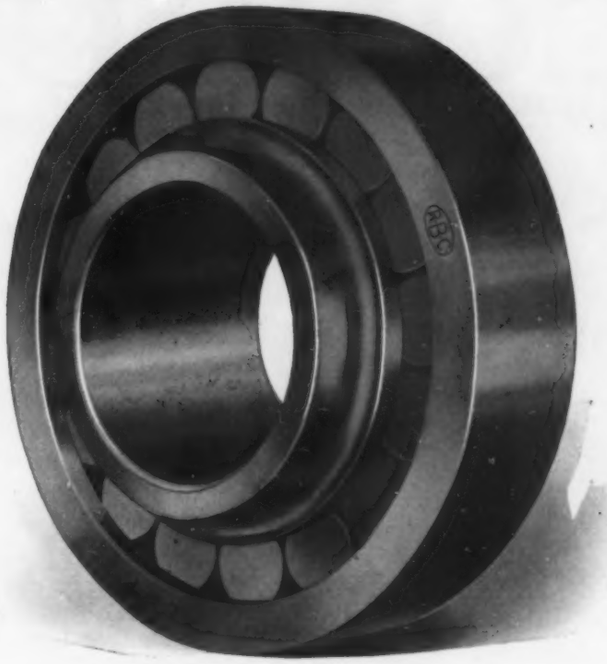
N L Products Manufactured and Sold in Canada by Railway Power & Engineering Corp., Ltd.
133 Eastern Avenue, Toronto, Ont.

RUGGED SIMPLICITY

is the outstanding characteristic of all

ROLLWAY BEARINGS

Built to survive under every-day conditions. **Rollways** ask no special favors either in operating or mounting.



WHETHER ON

CRANES
MILL TABLES
CENTRIFUGAL PUMPS
MOTOR DRIVEN SCREWDOWNS
INGOT CARS, or
REVERSING TABLES

ROLLWAY BEARINGS

ARE DEMONSTRATING THEIR SUPERIOR ABILITY to stand up without flinching under the day in and day out conditions that go with the various operations in STEEL MILL SERVICE.

YOU ENGINEERS WHO HAVE THEM IN OPERATION KNOW THESE FACTS. THOSE ENGINEERS WHO HAVE NOT OWE IT TO THEMSELVES TO INVESTIGATE.

Detailed information on ROLLWAY Bearing equipment for any type of motor in steel mill service on request.

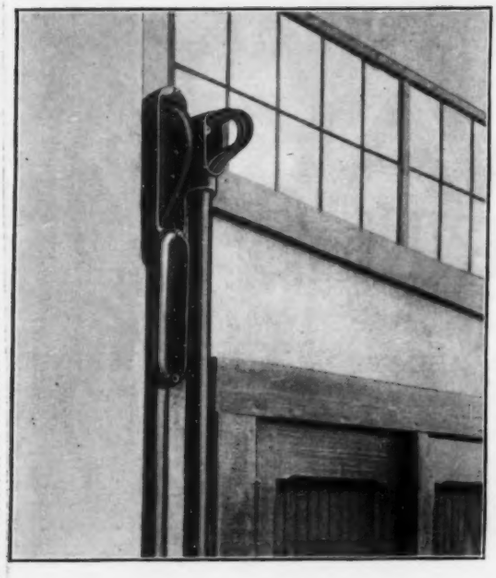
Made in SYRACUSE, NEW YORK, U. S. A., By ROLLWAY BEARING CO. Inc.

CONDULETS

Mogul Condulets For Large Cables

Actual Comparison of a Mogul and an Obround Condulet of the same size

Condulet the Job



THE CONDULETS
WITH
LARGE COVER OPENING
AND
LARGE WIRING CHAMBER

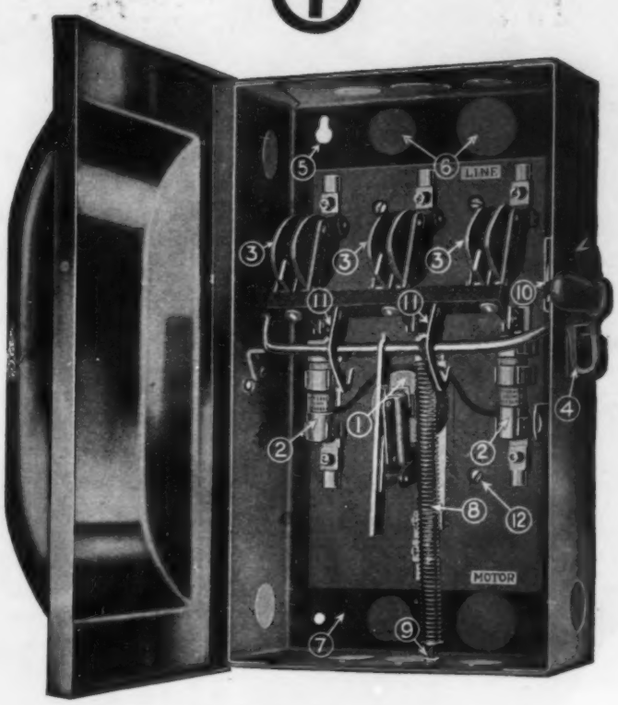
DO YOU KNOW ABOUT THEM?

Listed in Condulet Catalog 2000
Pages 37 to 39

CROUSE-HINDS COMPANY
SYRACUSE, NEW YORK

CROUSE-HINDS

Prevent Single Phasing with a New Trumbull Motor Starting Switch



This new line of Circle-T Type A Switches with Overload Relays and Under Voltage Release Coil gives positive motor protection under all conditions of starting and stalling—at a reasonable price.

The Overload Relays allow ample starting time and permit sufficient temporary overloading, but will trip out the switch before the motor is endangered. The relays are installed like cartridge fuses, but the clips are so spaced that a cartridge fuse cannot be substituted.

The Under Voltage Release Coils are of simple, magnet-type construction and can be adjusted to trip the switch open at any desired voltage limit. Both coils and relays are inside the switch-box, which is of the standard Type-A construction. You can get all the details from the new Motor Starting Switch Bulletin—get it today.

Special Features

1. Under Voltage Release Coil, magnet type mounted on the slate.
2. Overload Relays, protect motor from single phasing, practically indestructible.
3. Snuf-Arcs on 440 and 550 V. A. C., interrupt and extinguish excess arc due to blocked motors.
4. "Locking Off" Shelf, switch can be locked open.
5. Button Hole for fastening screws.
6. Knock-outs, large variety of sizes.
7. Ample wiring room.
8. Opening Spring, opens the switch on overload or under voltage.
9. Adjustable spring anchor, regulates tension of opening spring.
10. Interlocking Catch, provides safety in opening and closing box.
11. Quick Break Springs.
12. Entire switch easily removed from box.

TRUMBULL OVERLOAD RELAYS

All Relays are made the same size, but vary in capacity from 1 to 36 amps., effective on any voltage up to 600 V. A. C. Change of relay capacity will change the capacity of the switch.

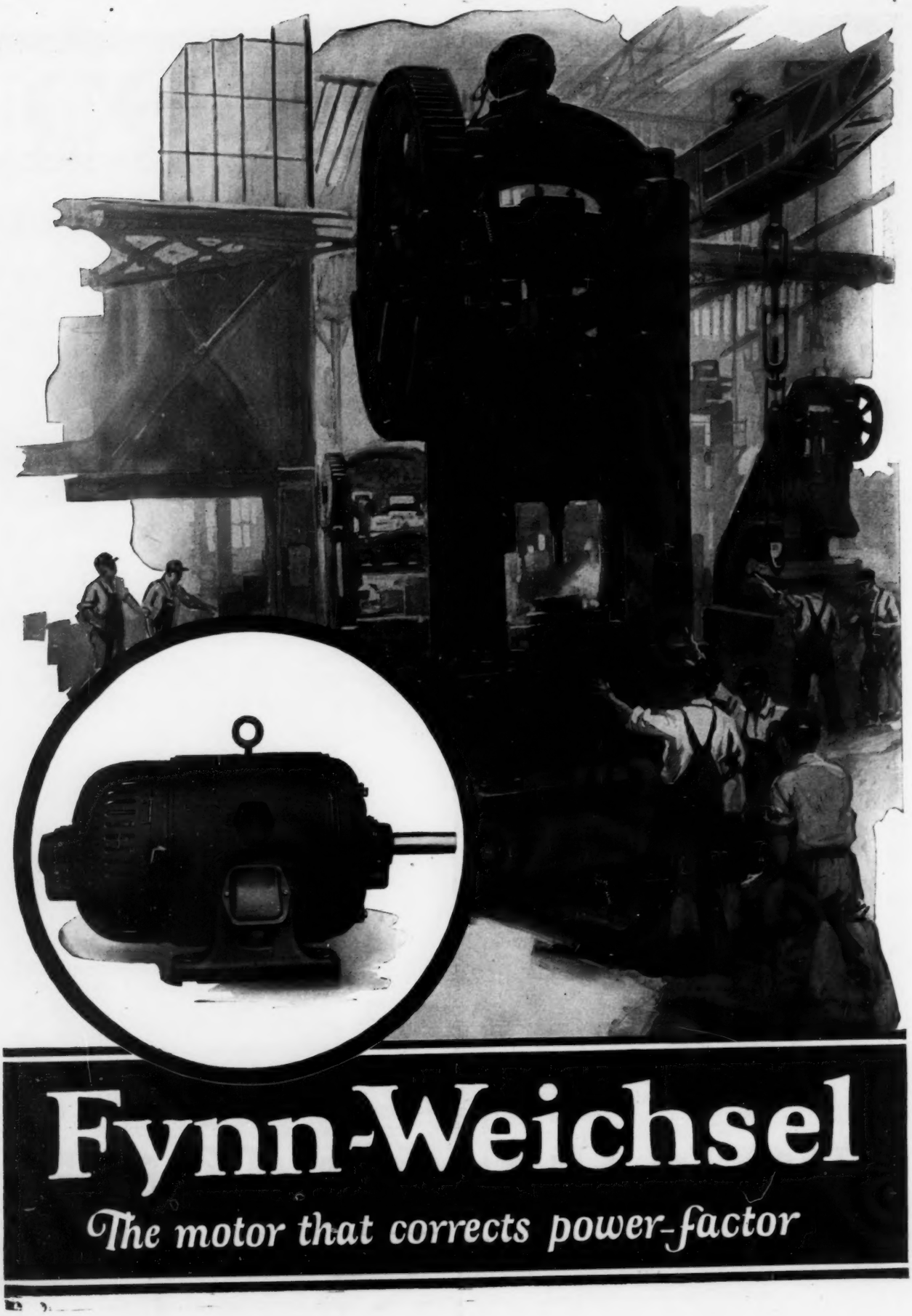
You can get all the details of the complete Trumbull Line by asking your jobber for Bulletin No. 5.

The Trumbull Electric Mfg. Company

114 Liberty St., New York City
595 Mission St., San Francisco, Cal.

Plainville, Conn.

2001 W. Pershing Rd., Chicago, Ill.
Boston Philadelphia Atlanta


Fynn-Weichsel
The motor that corrects power-factor

Do your motors quit when the voltage slumps?

INDUCTION motors if working anywhere near capacity, will not stand for an appreciable drop in voltage without slowing down, overheating or perhaps stopping altogether.

The most frequent cause of voltage drop and serious interference with motor operation is poor power-factor. The usual remedies for bad voltage conditions are larger wires, higher voltages or installation of power-factor corrective apparatus. Any of these means *expense.*

THE FYNN-WEICHSEL MOTOR furnishes a remedy *without extra operating expense.*

THE FYNN-WEICHSEL MOTOR operates at better overall efficiency than an induction motor and without extra operating cost compensates for the poor power-factor of induction motors employed at other points on the line, thus correcting power-factor and its attendant voltage troubles.

WAGNER ELECTRIC CORPORATION

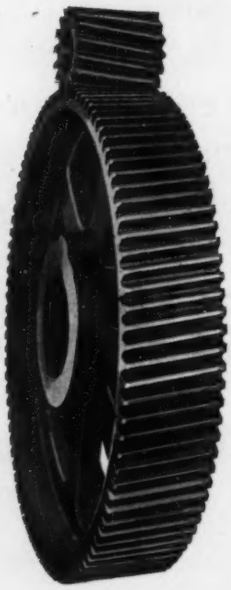
SAINT LOUIS

WAGNER ELECTRIC CORPORATION You may send me—without obligation on my part—a copy of your bulletin No. 134, describing THE FYNN-WEICHSEL MOTOR.	NAME
	COMPANY
	STREET
	CITY STATE

9120-7

Nuttall

HELICAL GEARS



Helical Gears

If you could cut a spur gear in 1,000 sections across its axis and assemble each section a thousandth of an inch ahead of the other you would in effect have a Helical Gear.

Each tooth would engage its load in a thousand steps instead of in one impact as occurs with spur gears. This not only lengthens the life of the gears, but of the machinery they drive.

The elimination of noise, vibration and jar is a wonderful relief in any plant, and it is entirely possible to eliminate gear noise in your plant.

Send for our special proposition

R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

Philadelphia Office
420 Land Title Bldg.

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2133 Conway Bldg.

SAFETY
V·V
SWITCHES
"SAFETY SWITCHES
FOR
EVERY PURPOSE"
Type BGS
Steel Mill Type
"V-V"
TYPE BGS
30-60
100-200
Ampere
250-500
600
Volts
Type BGS
Shows Top
Casing in Place
Type BGS with
Top Casing
Removed.
SAFETY
for
OPERATOR
and
ELECTRICIAN
For Use Where Occasion Necessitates Quick
Replacement on Live Lines
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P. H. Schaum
933 Liberty Ave.
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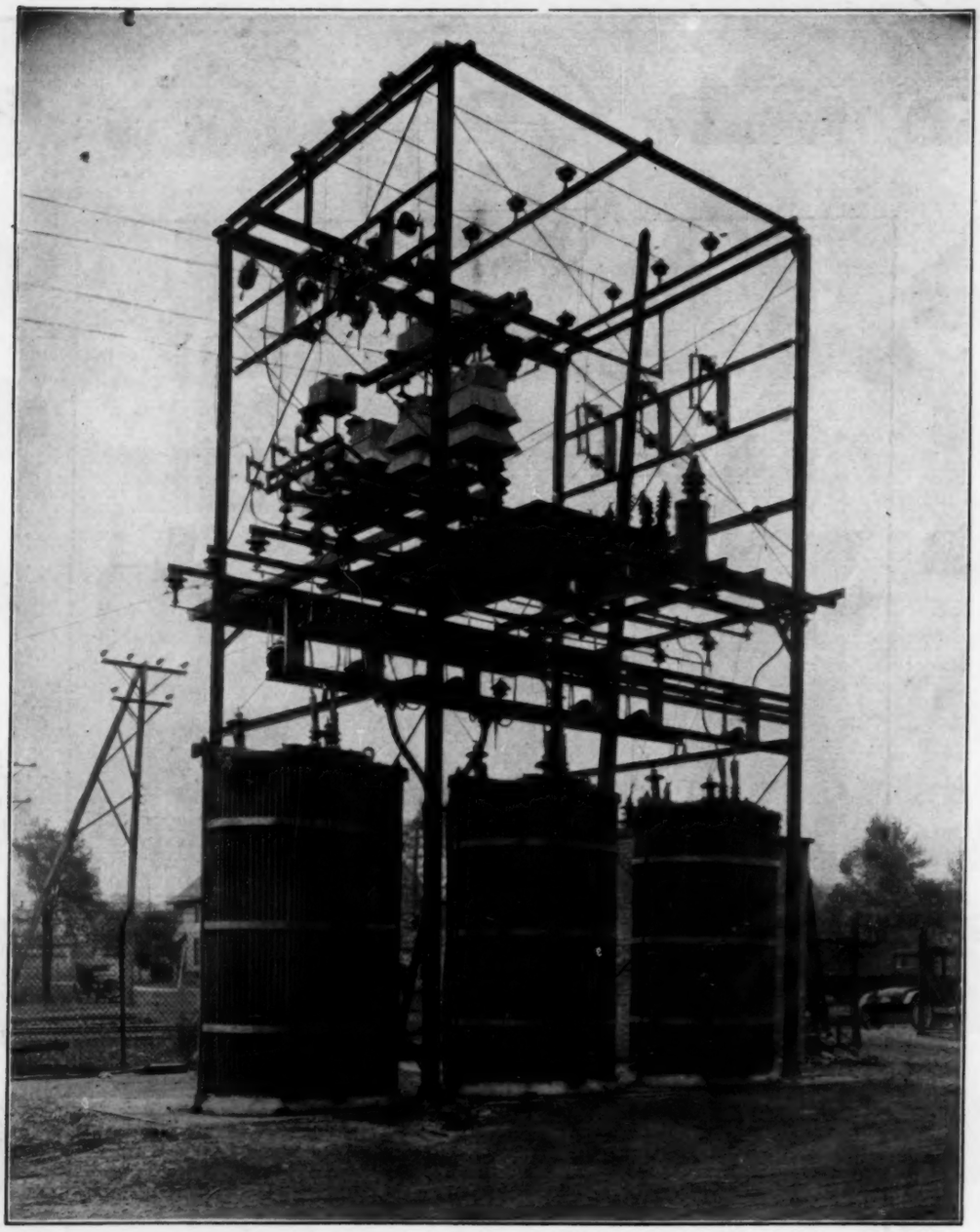
S. R. Shepard
1240 Ontario St.
CONDUIT
V·V
FITTINGS



Continuity of Power Supply

and Continuity of Operation go hand in hand.

Installation of PACKARD Transformers is the best insurance against interruption of service and cannot wisely be overlooked.

Complete information can be had upon request and our experience of over thirty years in the manufacture of high quality transformers is always at your service.

The Packard Electric Company

Warren, Ohio

TRANSFORMER MANUFACTURERS SINCE 1890

PIONEERS in adopting large Combustion Chambers

THIS company as early as 1916 was building and recommending Water Tube Boilers with four and one-half cubic feet of Combustion space per rated horsepower. The advantages and efficiency of large combustion chambers is today recognized by all leading engineers and boiler manufacturers.

This is typical of many improvements in boiler design and construction,—originally fostered and developed by this Company.

WATER TUBE BOILER LADD

PATENTED (OTHER PATENTS PENDING)

THE GEORGE T. LADD COMPANY

Manufacturers of Ladd Water Tube Boilers

Pittsburgh First National Bank Building **Pennsylvania**

CHICAGO OFFICE
McCormick Bldg.

PHILADELPHIA OFFICE
504 Franklin Bank Bldg.

G-E 7000 h.p. (continuous) Reversing Blooming Mill Motor and its Fly Wheel Motor Generator. This is one of two G-E equipments which are the largest electric reversing mill drives ever constructed in this country

Big Tonnage with G-E Motors

Bethlehem Steel Co.—Sparrows Point, Md.

A G-E Motor driving 40″ reversing blooming mill rolled a 23″ x 43″ ingot, 16,500 lb., to a 9″ x 38″ slab in 1 min. 20 sec.; and to an 8″ x 8″ bloom in 2 min. 15 sec. It has rolled 330 tons of 10″ x 40″ slabs in 1 hr., 198 tons of 8″ x 8″ blooms in 1 hr. Has also rolled 50,653 tons of finished product in a month consisting of 26 double turns representing over 60,000 tons of ingots.

Trumbull Steel Co.—Warren, Ohio

A G-E Motor driving 36″ reversing blooming mill rolled a 20″ x 22″ ingot, 6,700 lbs., to a $6\frac{3}{4}$″ x $6\frac{3}{4}$″ bloom in 58 sec. requiring 13 passes. Sixty such ingots were rolled to same section in 1 hr., requiring same number of passes. Total number of passes by mill—780, average 4.6 sec. per pass, including time between passes and ingots. During the process of making these 780 passes approximately 15,000 linear feet of metal passed through the rolls.

The manufacturing and engineering facilities of the General Electric Company are unsurpassed. G-E specialists on steel mill electrical equipment are available for co-operative work with steel plant engineers.

Bulletin No. 48031

Every type of electrical device which can find advantageous application in a steel plant fully equipped for electrical operation can be supplied by the General Electric Company. The above Bulletin gives valuable and interesting information about these products and their application to the production of iron and steel. You can secure it upon request.

General Electric Company
Schenectady, N. Y.
Sales Offices in all Large Cities

43B-740

GENERAL ELECTRIC

POSITIONS WANTED

ELECTRICAL Engineer, 10 years' practical experience
blast furnaces desires to make a change; married; b
references. Write No. 100, c/o Iron and Steel Engineer.

POSITION Wanted as chief electrician or assistant ele
superintendent of industrial plant, steel mill or power
12 years of practical electrical experience, in construction,
tenance, 5 years' experience in designing electrical layout
estimating for steel mills, industrial plants, sub-station
power houses. Registered electrical engineer. P. O. Bo
St. Louis, Mo.

POSITION Wanted as mechanical and electrical engine
technical graduate with 18 years' practical experience
erection of power houses, installation and maintenance of
mill machinery; 3 years' experience operating gas engine
generating station. Write No. 101, c/o Iron and Steel Eng

POSITION Wanted as electrical engineer by technical gra
with 15 years' experience in the design, installation and
tion of steel mills, and 3 years' experience in combustion
Is employed at the present time by one of the large steel
panies but desires a change. Write No. 102, c/o Iron and
Engineer.

POSITION Wanted as electrical engineer by a technical g
ate with 20 years' experience in the installation, operatio
maintenance of electrical apparatus with one of the largest
companies in the country. Best of references furnished.
No. 103, c/o Iron and Steel Engineer.

POSITION Wanted by an electric furnace operator who
the present time employed with one of the largest pla
this country. Is capable of handling not only the electric
plication but is able to melt steel. In all, has had about 10
experience in the installation and operation of steel mil
chinery. Write No. 106, c/o Iron and Steel Engineer.

POSITION Wanted by graduate of Polytechnic Institute
has spent two years with one of the largest electrical
facturing firms in the country. Is at present employed b
of the large steel companies in their engineering depart
Has had a number of years' experience in substation and
house work. Write No. 104, c/o Iron and Steel Engineer.

POSITION Wanted as sales engineer by technical graduate
has formed a very close contact with the steel mill and
road interests. Has an intimate knowledge of the require
of railroads, due to his work for the railroads bringing h
contact with practically all of the steel companies throughou
country. Best of references furnished. Write No. 105, c/o
and Steel Engineer.

MANUFACTURERS' Agent, calling on steel mills, indu
plants and central stations would like to add a new li
electrical equipment to his present accounts. Is well establ
in the Pittsburgh District. Write 107, c/o Iron and Steel
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1922 YEARLY PROCEEDINGS

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